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Government Shipbuilding Statistics

In the annual report of the Commissioner of Navigation, recently published, in which shipbuilding statistics are given for the fiscal year ended June 30, 1914, and also for the construction during the current fiscal year, it is pointed out that a diminished output from the shipyards on the seaboard is to be expected. This diminution, however, is not due entirely to the effects of the war, although in Germany the construction of merchant vessels has ceased, and in Great Britain much of the merchant work has been delayed, or temporarily suspended, in order that naval construction may be pushed to completion. With the shipyards in foreign countries suffering heavily from loss of merchant construction, there are excellent prospects, however, of an increase in merchant work in the shipyards of neutral countries. If the rapid increase in freight rates in the transatlantic trade is a reliable indication of the increased demand which will soon be felt for over-seas tonnage, neutral shipyards should certainly benefit from it. The total amount of tonnage built in the United States during the fiscal year covered by the Commissioner's report was 316,250 gross tons, as compared with 346,155 gross tons from the previous year. An analysis of the year's construction shows that 46 of the 1,151 vessels built aggregated 59 percent of the total tonnage built and bears out the tendency which has been noticed in recent years towards the construction of larger vessels both for freight and passenger service.

Shipbuilding Prospects

Although the decrease in the volume of tonnage turned out by the shipyards in the United States in 1914 was not wholly unexpected, there has been, nevertheless, at the end of the year an encouraging turn for the better. Within the last few weeks orders have been placed for the construction of seven new steamships, bids have either been asked or already been submitted for ten other steamships and, it is reported, inquiries are now out which indicate the placing of contracts for as many as twenty additional steamships in the near future. The vessels already ordered include two oil-tank steamships of about 14,900 tons deadweight capacity for the Standard Oil Company. This order has been placed with the Newport News Shipbuilding & Dry Dock Company, and the new tank ships will be the largest ever built in the United States. The Newport News company also has an order for a freight steamer of over 3,000 gross tons for the Porto Rico Steamship Company. Orders have been placed with the Maryland Steel Company for a freight steamship of over 3,000 tons for the A. H. Bull Steamship Company, a freight and passenger steamship of over 3,000 tons for the Munson Steamship Company, and a tank steamer of 8,000 tons deadweight capacity for the Anglo-Saxon Petroleum Company of London. This latter company has also placed a contract for a duplicate of the tank ship with the Harlan & Hollingsworth Corporation. The awards of contracts for the new naval destroyers, which were made after the shipbuilding report, published elsewhere in this issue, was compiled, gave the Fore River Shipbuilding Corporation two vessels, the Bath Iron Works two vessels, and the William Cramp & Sons Ship & Engine Building Company and the Mare Island Navy Yard one vessel each. It is also probable that the naval programme for the coming year will be fully in keeping with the policy of the present Administration as exemplified in the last naval appropriations. On the whole there is every indication that the tide in shipbuilding in the United States has turned and further improvement may be expected.

Coaling Ships at Sea

A development which is of much importance to the naval powers of the world is the recent progress which has been made in refueling warships at sea. In the paper on this subject, read before the Society of Naval Architects and Marine Engineers, attention is directed to the fact that of the hundred coal-burning cruisers of the British fleet said to be patroling the North Sea, probably fifteen are frequently, if not continually, absent from patrol service replenishing their coal bunkers in English harbors or English roadsteads. It is obvious that every vessel withdrawn from patrol service in a blockade to refill its coal bunkers materially decreases the efficiency of the blockading fleet. Although the efficiency of the present British patrol may be as high as 85 percent, such a blockade could be maintained at nearly 100 percent efficiency if it were possible to coal the ships from colliers while at sea. Extensive experiments with apparatus for performing this service have been carried out by both the British and German Admiralties, but in no instance has the success attained been greater than in the case of the American naval colliers, which have been equipped with the marine cableway developed by Mr. Spencer Miller. This apparatus is the outcome of study and experiments covering a period of twenty-one years. It is

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operated by a new form of marine machinery known as an automatic tension engine, which by means of a specially devised tension governor maintains a practically uniform tension in a cable connecting the collier with the ship to be coaled, and over which the coal is transferred. The governor device is such that the slightest change in the tension of the suspended cable produces a corresponding and proportionate change in the steam pressure operating the tension engine. A slackening of the suspended cable produces an instant increase in the steam pressure sufficient to restore the tension to normal and, conversely, a tightening of the suspended cable produces an instant reduction of steam pressure permitting the cable to pay out until the tension is restored. Tests have shown that loads up to 4,000 pounds can be picked up from the deck of the collier and transported about 500 feet and dropped on the deck of the ship to be coaled at intervals averaging one minute and six seconds and frequently at intervals of less than one minute. This apparatus has been tested in heavy seas and in cases where the coaling was accomplished in a dense fog in which neither ship was visible from the other. A successful device for rapidly coaling ships at sea is a development which will add much to the efficiency of a naval fleet in time of war, and its need has been amply demonstrated in the European war now in progress.

New Ships Needed for the Coast and Geodetic Survey

Two things are needed to carry on in an efficient and satisfactory manner the important service of the Coast and Geodetic Survey. These are new ships and adequate funds for their maintenance and operation. At present twelve vessels are employed for this service, the average age of which is 27.2 years. Two of the vessels are over fifty years old; three over thirty years old and the latest addition to the fleet was built ten years ago. They are all moderate-sized vessels, the largest being 168 feet long, of 690 gross tons. Nearly all of them, however, are so antiquated and inadequately equipped that they seriously interfere with the satisfactory performance of the duties of the Coast and Geodetic Survey, and the need for the replacement of at least several of them is most imperative.

In his annual report, the Secretary of Commerce, under whose jurisdiction the Coast and Geodetic Survey is placed, points out that this survey is not only the oldest scientific service of the government, but that it is also the greatest of its kind in the world. There are several times as many miles of coast in Alaska alone as in the entire United Kingdom of Great Britain and Ireland. The surveying and charting of the Philippines, which falls to this service, is of itself a far greater task than is imposed upon France on all her own marine borders in Europe. Furthermore, the surveying of the Hawaiian Islands, of Samoa, Guam and Porto Rico is a greater task than similar work upon the European coast of Germany. A most striking comparison, showing the extent of this service, is shown by the fact that the reach of the Alaskan and Aleutian shores east and west is equal to the distance from Charleston, S. C., to San Digeo, Cal., and that north and south it covers as much distance as from the Canadian line to the Mexican border. As compared with similar work in Great Britain, the work in the United States is four times as great and the service is provided with eighty less officers and men and 2,000 less tons of shipping.

As an example of the handicap which this service undergoes in the matter of the ships at their disposal, the Secretary of Commerce cites the case of three of the ships which he personally investigated. These are the *Endeavor*, 111 feet long, 18.5 feet beam, of 130 gross tons, a relict of the Civil War, built fifty-two years ago; the *Gedney*, 140 feet long, 23¾ feet beam, of 244 gross tons, built thirty-nine years ago, and the *McArthur*, 115 feet long, 20½ feet beam, of 220 gross tons, built thirty-eight years ago. These three obsolete ships are single-screw steamers driven by single-cylinder engines. They are without electricity for wireless or for lighting; without refrigerating plants; without distillers for making fresh drinking water, and with quarters for the officers and crew which are wholly inadequate and are almost uninhabitable considering the conveniences now provided in practically every modern steam vessel. The *Endeavor*, now operated in sheltered waters on the Atlantic Coast, is unfit to survive the voyage to the Pacific, where she is greatly needed; the steamers *Gedney* and *McArthur*, while still capable of service in sheltered waters in the Pacific, are wholly unfit for the service.

To show some of the conditions under which the surveying staff are obliged to work, the Secretary describes in detail the arrangement and equipment—or, rather, lack of equipment—of these vessels. The *Endeavor*, with an inadequate single-cylinder engine of the keel-condensing type, under favorable conditions makes a speed of eight knots; against a head wind and a seaway, however, she will at full speed not exceed five knots, and in a heavy sea she will make little or no headway at all. The living quarters are inadequate and unsanitary, and the average cost for repairs to this vessel during the last ten years has been $2,123 (£435)—a total of $21,229.47 (£4,350), or 104 percent of the original cost in one-fifth of the time she has served. The same average amount will be required for repairs at the close of the present season.

The *McArthur*, equipped with machinery similar to that in the *Endeavor*, is capable of a speed of eight knots under favorable conditions, and only six knots against a moderate sea. The boiler now in the vessel was built in 1889, and was then designed for a pressure of 110 pounds. Its safe limit now is 80 pounds. During the last ten years the average cost for repairs on the vessel has been $3,123 (£640)—a total of $31,234 (£6,400), or 56 percent of the original cost. During a quarter of her working life it has cost one-half of her original expense to keep her fit for service. Not less than $2,000 (£410) will be required for repairs at the close of the fiscal year. The other vessel, also fitted with inadequate machinery,

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is capable of an average speed of 7½ knots under favorable conditions. The average annual cost for repairs during the last ten years has been $2,160 (£442)—a total of $21,600 (£4,420), or 34 percent of the original cost. About $2,000 (£410) will be required for repairs at the end of the present season.

Apart from the unfitness of these vessels for their work and from the danger of operating them in heavy weather, another feature which militates against their continuance in service is the costly waste of time which results from a lack of funds for their operation. On account of their slow speed and the impossibility of staying at sea in any but moderate weather, their actual output is reduced by nearly 20 percent. Furthermore, as the Coast and Geodetic Survey is not provided with sufficient funds to keep the vessels in service continually, the *McArthur,* for instance, was idle for 25 percent of the last fiscal year, the *Gedney* was idle for three months from lack of funds, and the other ships have suffered accordingly.

It is proposed to replace these vessels with seaworthy steamers 130 feet long, of about 500 gross tons, driven by twin screws actuated by compound engines supplied with steam from watertube oil-burning boilers, and fitted with electricity for wireless signals, lights and complete auxiliaries, including a refrigerating plant. Comfortable and sanitary quarters and sufficient working space will be provided for the crews and officers. Such vessels would be able to go on cruises of six or seven months' duration in places remote from settled regions, and they could carry an outfit capable of meeting emergencies. As an appropriation of only $500,000 (£102,500) is being asked for these new vessels, Congress should speedily make the necessary appropriation to meet this imperative need.

Electrical Propulsion on Battleships

The confidence evidenced by the Navy Department in the future of electrical propulsion as applied to battleships apparently is well founded when it is known that in the case of the naval collier *Jupiter,* where the installation of electric drive proved entirely successful, the builders of the machinery themselves did not wholly approve of this installation; for, while they were absolutely confident of its success, they knew that such an installation did not offer the possibilities for demonstrating the special advantages of electrical drive to such an extent as would be the case on a battleship. The *Jupiter* was a one-speed boat; that is, she was designed for economical operation at a single speed, whereas, in the case of a battleship, it is of great importance that the machinery shall operate economically at a slow or cruising speed and, at the same time, be capable of operating at full speed with the best possible economy. With electric drive it will be possible to get the same, or even better, results at a cruising speed of, say, 12 knots as at the full speed of 20½ knots, whereas in a direct turbine-driven ship the best economy which is obtained at full speed cannot be maintained at cruising speeds.

A splendid opportunity for comparison will be offered between the *California,* fitted with electric drive, and the *Pennsylvania,* fitted with direct connected turbines and geared cruising turbines. On the *Pennsylvania* an efficiency of about 61 percent will probably be obtained, the propellers turning at 220 revolutions per minute, while on the *California* an efficiency as high as 75 percent is confidently expected, the revolutions of the propellers being only 160 per minute. The slower turning propellers will offer an opportunity to regain a part of the losses in the electrical transmission on account of the increased efficiency of the slow-running propellers. The claims of 75 percent, and even more, for the efficiency of electric drive, are founded on results already obtained with similar machinery in shore installations, and are very favorable as compared with the figures for the efficiency of direct turbine drive as already obtained from the operation of such vessels as the *Lusitania* and a number of naval vessels where an efficiency of 63 percent was obtained.

One of the first points to be considered in the installation of electric drive is its reliability. On a battleship the machinery will consist of two turbo generators running at a maximum speed of about 2,000 revolutions, generating current at about 3,000 volts, and four induction motors of the double squirrel cage type arranged on four shafts. The stators of the motors will be fitted with pole changers which will give the motors two different numbers of poles, and, consequently, two speed reductions. In such an installation, reliability is gained from the fact that the installation is in duplicate and the breakdown of one engine does not affect the ship except at high speeds. With only one turbo generator in operation the ship can run in a perfectly normal manner with normal efficiency up to a speed of about 19 knots. As pointed out by Mr. W. L. R. Emmet in the discussion of the paper on electrical propulsion presented at the naval architects' meeting, electrical machinery is not exactly a unit, it is a collection or combination of various parts, so arranged that it is practically impossible for the entire installation of machinery to be completely wrecked. Under intelligent care the generator can be made to run even if many things happen to it. Reliability is also gained from the fact that the turbines always operate in one direction and the danger of blading trouble is thereby reduced to a minimum. There is also a gain in efficiency in backing, whereas in any other form of drive losses are bound to occur in reversing the engines. According to Mr. Emmet, gains in economy are also possible with the electric drive by improvement in the operation of the auxiliaries. Although the auxiliaries in the electric-driven *Jupiter* proved more economical than those in her sister ships, the steam consumption for the auxiliaries was, nevertheless, far beyond reason. To improve these conditions on a battleship installation it is proposed to install a turbine-driven exciter of large enough capacity to furnish the current for operating the auxiliaries, and thereby materially reduce the water rate of the auxiliaries.

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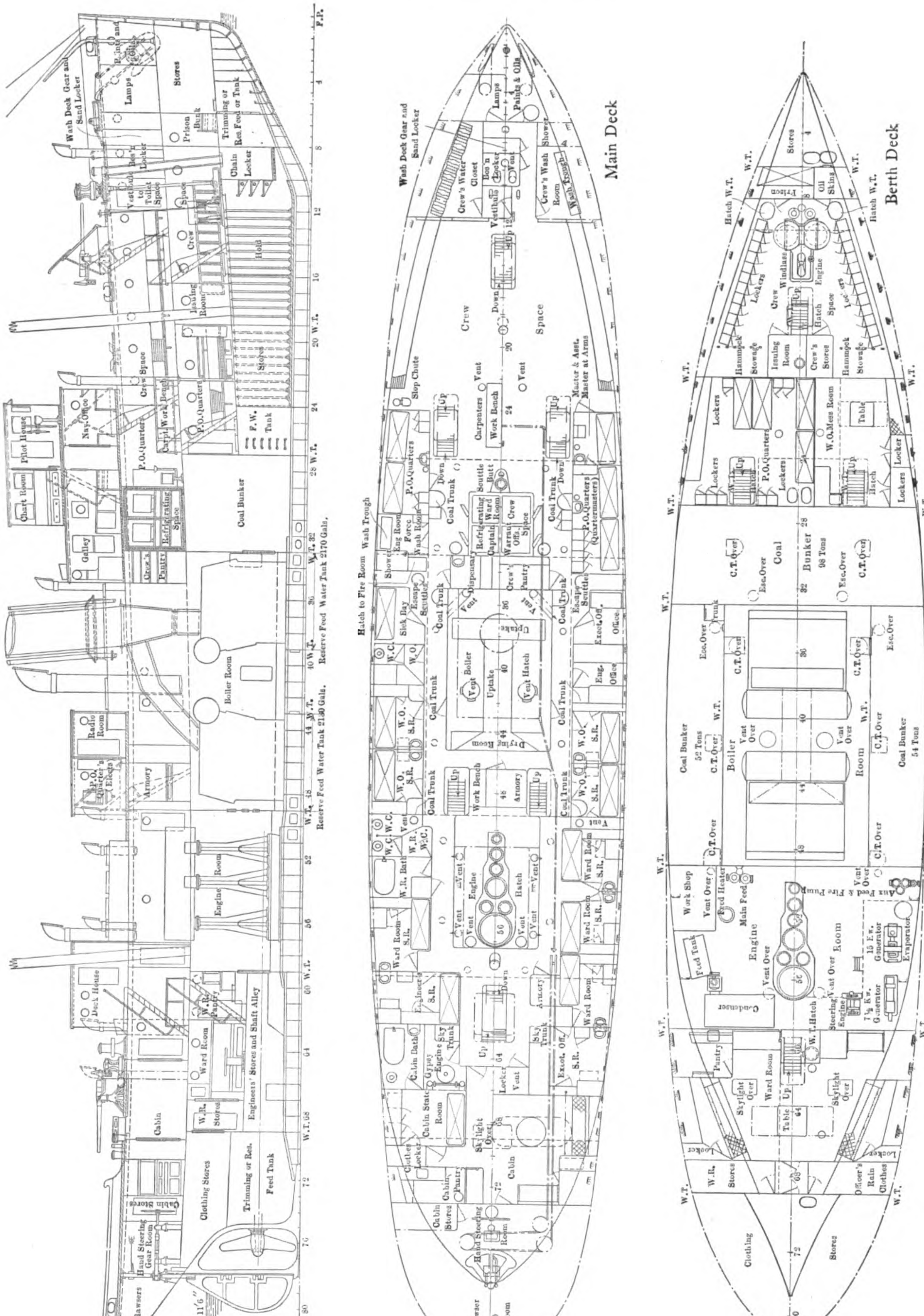

Fig. 1.—Profile and Deck Plans of New Revenue Cutters Building at Newport News

New United States Revenue Cutters

Description of the Hull and Machinery of the Latest Revenue Cutters Now Under Construction at Newport News

The two new United States revenue cutters now being built by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va., are sister ships, each 165 feet 6 inches long overall, 150 feet long between perpendiculars, 32 feet beam molded, with a depth of 20 feet 9 inches. Their displacement at a mean draft of 11 feet 6 inches, with 200 tons of coal, 13,000 gallons of fresh water and 12 tons of stores on board will be 900 tons. They are of the flush deck type, with the schooner rig, and accommodations are provided for eight officers and a crew of sixty men.

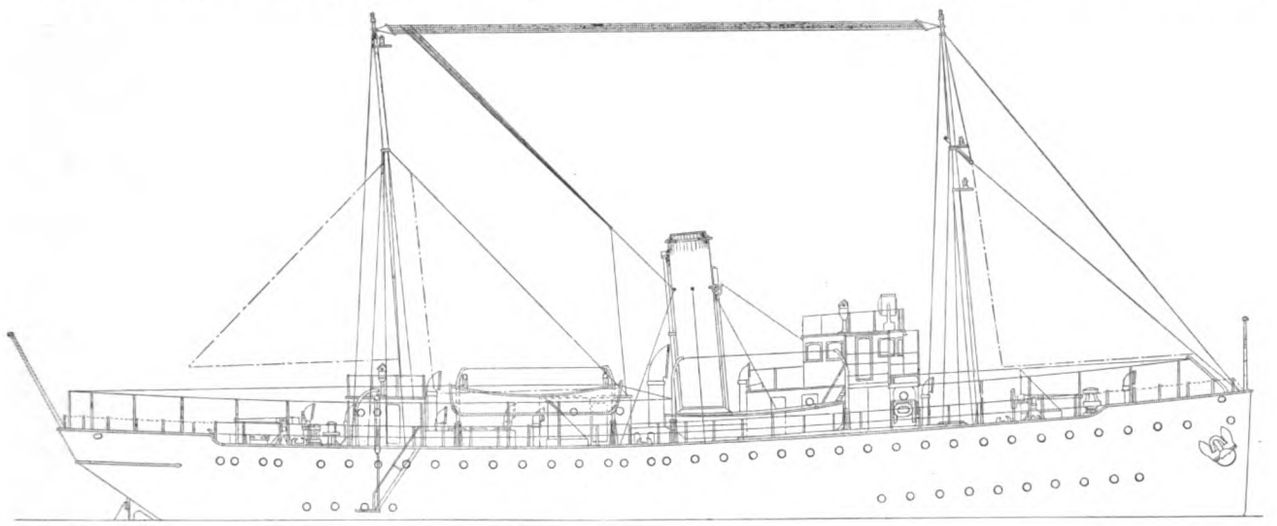

Fig. 2.—Outboard Profile of the New Revenue Cutters

One of the vessels has been designed to replace the revenue cutter *Woodbury,* stationed at Portland, Me., and the other to replace the old cutter *Winona,* now stationed at Mobile, Ala. The only difference between the two ships is that the cutter for service on the coast of Maine will be especially fitted for breaking ice in the harbors and along the coast of Maine. Both vessels will be fitted with every modern means of rendering aid to vessels in distress, of destroying derelicts and for other purposes of the revenue cutter service.

General Arrangement

The hull of each vessel is subdivided by 7 watertight bulkheads, all of which, with the exception of two just aft of the forward collision bulkhead, extend to the upper deck. There are three decks, designated as the upper deck, main deck and berth deck. The upper deck is a flush deck and on it amidships is a steel deck house containing at the forward end the navigating office, over which are the pilot house and chart room. Aft of the navigating office is the galley and radio room, with the petty officers' quarters arranged just forward of the engine room hatch. The main companionway is in an after deck house.

On the main deck forward are the lamp and paint rooms, the boatswain's locker and then the crew spaces. Aft of the crew spaces are quarters for the petty officers and a refrigerating room, immediately aft of which is the crew's pantry. The main cabin is aft on this deck, while the quarters for the officers are alongside the engine and boiler hatches.

On the berth deck forward is a storeroom and the ship's prison. Aft of this is space for the crew, and still aft of this on the port side, quarters for the petty officers, and on the starboard side the warrant officers' mess. The machinery space is taken up first by an athwartship coal bunker of 98 tons capacity, then the boiler room with wing bunkers on each side, after which is the engine room and then the ward room, and finally space for stores.

Hull Construction

The stem is of cast steel in two parts, webs being worked inside the castings to take the keel, floors and decks. The stern frame, consisting of the propeller post and rudder post and the parts between them forming the counter and shoe, is a steel forging, the propeller post being 6½ inches wide by 4 inches thick, and the rudder post of the same size, pear-shaped on the forward side and provided with stops to prevent the rudder from swinging more than 40 degrees each side of the centerline.

The rudder is of the double plate type, the frame being forged solid in one piece, covered with 12-pound plates riveted through the frame and calked.

The frames are 4 inches by 3 inches by 8.5 pounds angles, joggled at the outside plating laps to avoid the use of liners at the frames. In the bow the frames are spaced 16 inches and throughout the rest of the vessel 24 inches apart. The frames in general are continuous from the keel to the under side of the upper deck plating. The reverse frames are 3 inches by 3 inches by 7.2 pound angles for a half length amidships, reduced to 3 inches by 3 inches by 6.1 pounds at the ends. The reverse frames in the boiler room bilges, however, are increased to 3½ inches by 3 inches by 7.9 pounds. Forward of frame 8 the reverse frames were run to the main deck beam brackets, except on every third frame they will run to the under side of the upper deck beams. Abaft frame 8 the odd-numbered reverse frames will run to the main deck

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brackets and the even-numbered reverse frames to the upper deck beams.

The floors for half length amidships will be 16-pound plates reduced to 14 pounds at the ends, while in the boiler room and bilges inboard of the coal bunker bulkheads and not in reserve feed water tanks, the floors will be 20-pound plates. In the engine room, they will be 18-pound plates. In general, the floors are 22 inches depth at the throat.

Web frames will be located in the bunker and engine spaces as shown on the plans. The frame angles will be single 4 inches by 3 inches by 8.5 pounds, and the inner

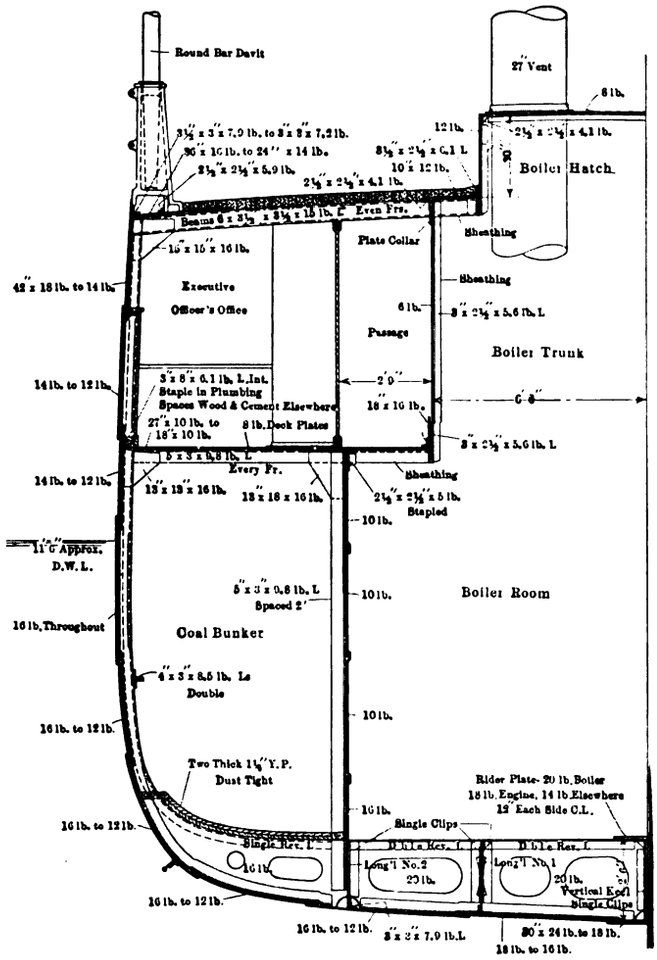

Fig. 3.—Midship Section

angle will also be single of the same size, the plate being of 16 pounds, 14 inches depth. The web frames extend from the coal bunker bulkhead or vertical keel, as the case may be, to the under side of the main deck.

In addition to the vertical keel there are two longitudinals on each side of the keel. The plating of the first longitudinal is 20 pounds in the boiler room, 18 pounds in the engine room and 14 pounds elsewhere. The longitudinal is continuous in wake of the fresh water tanks and throughout the boiler room. Elsewhere the plating is intercostal. The angles of the longitudinal are as shown in the midship section. The second longitudinal is worked as a continuation of the fore and aft coal bunker bulkheads and is of 14-pound plate worked intercostal.

The vertical keel, which extends from frame 4 to 69, is in general 26 inches deep, although increased in depth in the boiler and engine room. The outer angles are double 3½ inches by 3½ by 8.5 pounds continuous throughout. The inner angles are of the same size, continuous between frames 32 and 60, and the boiler and engine rooms. The vertical keel plates are 20 pounds in the boiler room and 18 pounds in the engine room, reduced in steps to 14 pounds at the ends.

The shell plating is worked in in and out strakes of the weights shown on the midship sections. The watertight bulkheads are built in horizontal strakes and stiffened by vertical angles spaced 24 inches apart. In the collision bulkheads the lower strake is 14-pound plating, above which is 12-pound plating to the main deck, while above that the plating is 10 pounds. Other transverse bulkheads below the main deck have the lower strake of 14 pounds and all strakes above 10-pound plating, except that the lowest strake of coal bunker bulkheads will be 16-pound plating.

Propelling Machinery

The main engine is of the vertical inverted cylinder direct-acting triple expansion type with cylinders 17, 27 and 44 inches diameter, with a common stroke of 30 inches. The engine is designed to develop about 1,000 indicated horsepower at normal speed. The valves are of the piston type for all cylinders, the valves being worked by Stevenson link motions with double bar links. The framing of the engine consists of three wrought steel front columns and three cast iron columns at the back. The bedplate is of cast iron supported on a wrought steel foundation built up from the frames of the vessel. The crank line and propeller shafts, the piston rods, connecting rods and working parts generally are of mild open-hearth steel.

The crank shaft is of the built-up type, while all other shafting is forged solid in one piece. The thrust shaft is forged in one section 8¾ inches diameter. The propeller shaft is 9½ inches diameter. There are six bearings for the crank shaft, each 8¾ inches diameter by 10 inches long, with the exception of the after low-pressure bearing, which is 8¾ inches diameter and 12 inches long. The stern tube is in one section with bearings at each end of the tube. The after bearing is 3 feet long and the forward bearing 2 feet long. The propeller is of cast steel with four blades of the built-up type, the diameter being about 10 feet 6 inches.

The engine is fitted with a reversing gear consisting of a steam cylinder 9 inches in diameter and 16 inches stroke, secured to the back side of the high-pressure back column. A turning gear is fitted to the crank shaft of the engine for turning it by hand.

The condenser is made with a cast iron shell ⅝ inch thick, 7 feet 3⅛ inches long between tube sheets and 3 feet 6 inches inside diameter. The condenser tube sheets are of rolled bronze, 1 inch thick, and there will be about 1,112 seamless drawn condenser tubes ⅝ inch outside diameter No. 18 U. S. S. G. thick, and 6 feet 8 inches long inside of the tube sheets, forming a cooling surface of about 1,328 square feet.

A combined feed and filter tank with a capacity of about 300 gallons is placed in the engine room, as shown on the general plans, and so arranged that the water from the air pump will be discharged at the top and then filtered successively through the divisions in the tank from the top, so that the filtering material will be readily accessible. A feed water heater, using auxiliary exhaust steam, is also installed in the engine room.

The pumps installed in each ship include the following:

One main circulating, vertical centrifugal, 24-inch runner, 5-inch by 6-inch engine.

One main air, vertical, single-acting, attached, 20 inches diameter by 11 inches stroke.

One main feed, vertical piston, double-acting, simplex, 10 inches by 6 inches by 12 inches.

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One fire and wrecking, vertical piston, double-acting, simplex, 18 inches by 10 inches by 18 inches.

Two bilge (attached), vertical, single-acting, 3½ inches diameter by 11 inches stroke.

One hand deck, double acting, 5 inches diameter.

One general service, horizontal, double-acting, duplex, composition water end, 7½ inches by 6 inches by 10 inches.

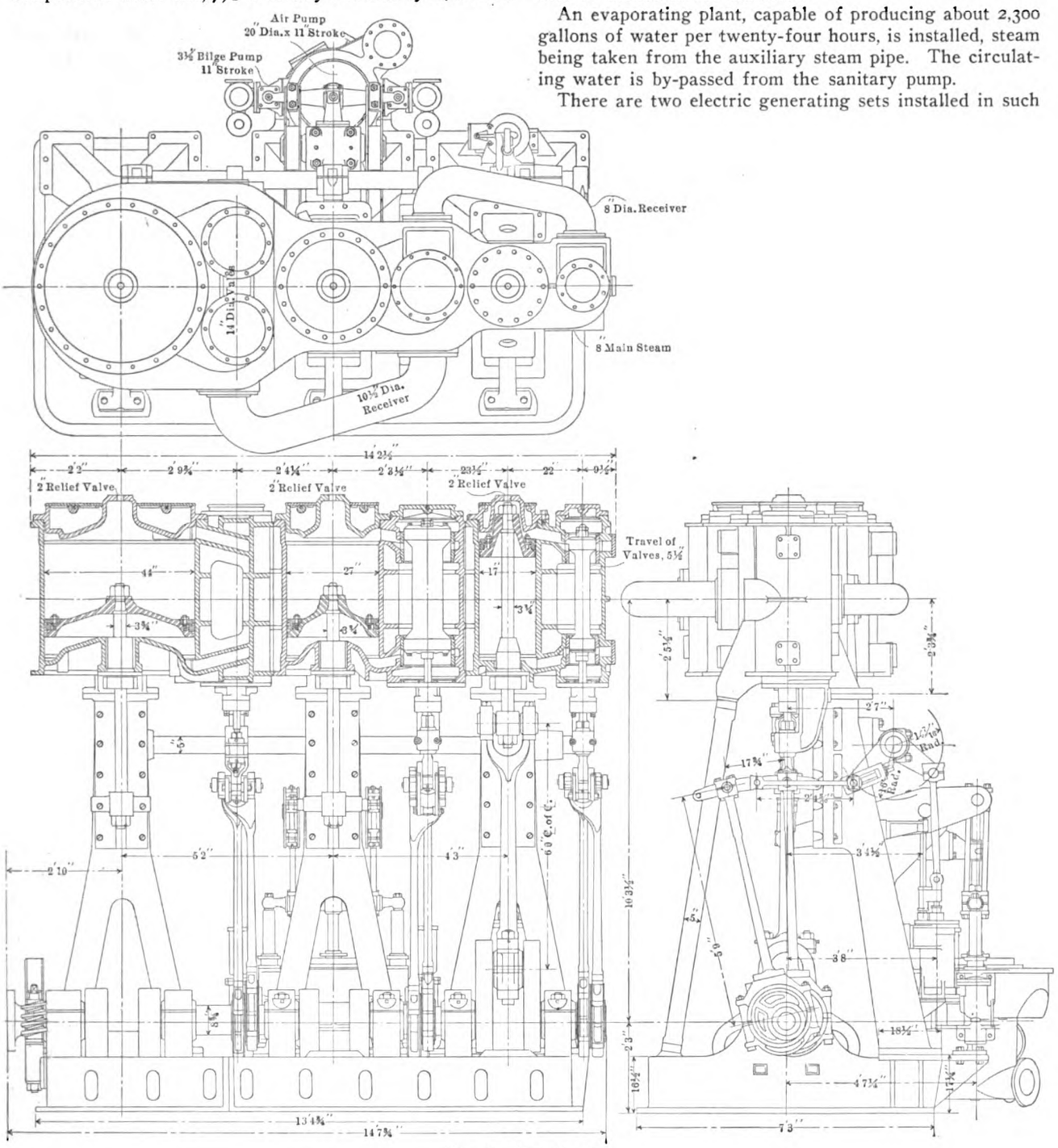

Fig. 4.—Main Engine

One fresh water, vertical, double-acting, 3½ inches by 3¼ inches by 6 inches.

Steam is supplied at 180 pounds working pressure by two watertube boilers located in a single boiler room. The general dimensions of the boilers are as follows:

Length over casing at bottom, 10 feet; width over casing, 12 feet; height to center of drum, 9 feet 10 inches; total grate surface, 123 square feet; length of tubes, 9 feet; total heating surface, about 4,400 square feet.

The steam and water drums are 42 inches inside diameter and the tubes, which are straight, 2 inches in diameter except the bottom row, which are 4 inches in diameter. The stack is 47 feet high above the grates and 4 feet 11 inches inside diameter.

An evaporating plant, capable of producing about 2,300 gallons of water per twenty-four hours, is installed, steam being taken from the auxiliary steam pipe. The circulating water is by-passed from the sanitary pump.

There are two electric generating sets installed in such a manner that either may be used to light the vessel and operate the searchlight, electric fans, shop tools and motor generator of the radio apparatus.

The main generating set is a 15-kilowatt, 125-volt direct-connected unit, driven by a reciprocating engine, while the auxiliary set is of 7½ kilowatts, 125 volts, actuated by a turbine.

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Naval Architects Annual Meeting

Upbuilding of the American Merchant Marine Discussed—Safety of Life at Sea and New Developments in Ship Propulsion

The twenty-second annual meeting of the Society of Naval Architects and Marine Engineers was held at the Engineering Societies Building, New York, December 10 and 11. On account of the illness of Colonel Robert M. Thompson, President of the Society, Stevenson Taylor presided at the meeting and read the presidential address.

The annual report of the secretary-treasurer showed the membership of the Society at the close of the annual meeting in 1913 to be 812. During the year five deaths occurred and sixteen members resigned, making the membership on November 1, 1914, 791. At the opening session of the twenty-second annual meeting 38 new members were elected, and before the close of the meeting several other applicants were elected to membership. The financial condition of the society was shown to be in excellent condition, the total resources amounting to $26,440.44 (£5,425) and the total liabilities to $575 (£118), making the society's present worth on October 31, 1914, $25,865.44 (£5,307).

The following deaths were recorded during the year: James G. Winship, Thomas Dolan, Gilbert N. McMillan, George N. Gardiner, Naoji Tomikawa.

Several changes were made in the constitution and by-laws of the society relating chiefly to the election of members of the Council and the management of the society. The following were elected vice-presidents for the term expiring December 31, 1917: W. I. Babcock, Rear Admiral W. L. Capps, Prof. W. F. Durand, Rear Admiral D. W. Taylor. Members of the Council for the term expiring December 31, 1917, were elected as follows: J. E. Denton, D. H. Cox, H. L. Ferguson, Prof. C. H. Peabody, F. L. Du Bosque, Prof. H. L. Sadler, H. S. Grove and H. L. Aldrich.

Rrear Admiral W. L. Capps, former chief constructor, U. S. N., was elected a life member of the society.

An expression of the society's attitude towards the upbuilding of the American merchant marine was made in the following preamble and resolution adopted by the society in the course of the meeting:

Preamble and Resolution Adopted by the Society

"It is beyond dispute that the development of the foreign commerce of a nation such as ours is seriously hampered so long as the carriage of that commerce depends upon the convenience and ability of foreign carriers; nor can it be denied that our nation has been paying tribute to foreign nations to perpetuate such foreign supremacy, to the detriment of individual opportunity and of our established system of wages and conditions of living.

"This Society, which has for its aim the advancement of the art of shipbuilding, takes this opportunity of submitting a recommendation to the President and Congress on the recognized necessity for rehabilitating our foreign service merchant marine.

"*Resolved*, that the interests of an important industry, involving both capital and labor, can be best served by encouraging shipbuilding in American shipyards and the operation of such ships under the American flag, and that any legislation relating to our merchant marine should recognize and increase the advantage of our nation's general system of industrial development. Therefore, it is believed that such additional legislation as may be enacted should have in view the relief of existing burdens and take account of the unquestioned additional cost of operating ships in accordance with the laws and industrial policy of our country.

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Articles 60 and 61 seem of especial interest to the Society of Naval Architects and Marine Engineers. The establishment of international standards of safety, coupled with the obligation upon each nation to guarantee that its own ships comply fully with the requirements of such standards, offers both positive and negative advantages to the successful prosecution of their work by a body of trained men such as compose the Society. The London Convention furnishes an impetus to high grade construction work in that it secures for such work international recognition. More than mere formality is intended by Article 64 of the Convention, by which the governments of the maritime powers agree to communicate to one another "all information which they possess affecting safety of life on those of their vessels which are subject to the rules of the Convention, provided always that such information is not of a confidential nature." This article was intended to mean that the best results of the best thought of ship and engine builders shall be exchanged between nations for critical study with a view to their incorporation, if practicable, into the rules fixing international standards of construction, and to facilitate this result the Convention in Article 74 provides "the governments may through the diplomatic channel introduce into this Convention, by common consent and at any time, improvements which may be judged useful or necessary."

The Convention applies to mechanically propelled ocean vessels (steam, motor and internal-combustion engines) which carry more than twelve passengers, in foreign trade between the nations which ratify the Convention. Each nation, of course, reserves its coasting trade for its own legislation. Each nation is at liberty to exempt from the

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The Convention was to have been ratified not later than December 31, 1914, and was to have taken effect on July 1, 1915, but the situation, of course, has been entirely changed by the events of August. Undoubtedly it will be necessary to extend by common consent beyond December 31, 1914, the period for the exchange of ratifications, and beyond July 1, 1915, the date when the Convention shall go into effect.

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After giving a brief statement of the work of the International Conference, the author designates which vessels in the United States will be affected by the convention. These vessels include existing or new passenger vessels which are or will be engaged in trades between the United States and the ports of any of the High-Contracting Parties of the International Convention, between the United States and the Philippines and between the United States and the Canal Zone. The existing vessels actually affected will be a few steamers trading between the west coast of the United States and the Philippines, a few in the transatlantic trade and the foreign steamers that may be registered under the new act approved on August 18, 1914. The Convention requirements will also be applied to all new passenger vessels which will be built for the foreign trade.

As the United States coastwise vessels do not come under this Convention, the author considers it advisable to consider such vessels with special regard to increased safety at sea. In order to show how the Convention requirements would affect a vessel in the coastwise trade, a typical passenger and freight steamer as used on the east coast of the United States is taken for investigation. It is found that this vessel, if affected by the Convention, will require two more bulkheads fitted forward unless the machinery space is placed further forward, or other arrangements made. This vessel will also require two watertight bulkheads in the after hold and to be fitted with a double bottom all fore-and-aft, whereas this vessel has only a double bottom in the engine room. If this vessel were built to conform to the Convention requirements, it will be seen from this example how some of the coastwise passenger and freight steamers would require more bulkheads in the hold and 'tween decks, the vessels would require more depth so as to allow of a double bottom being fitted, and to allow of the arrangement of the doors in watertight bulkheads, and through the vessel's side to be above the load waterline. It should be noted that in vessels where the watertight bulkheads are arranged according to the Steamboat Inspection Rules, the vessel will founder if she has any two adjoining compartments flooded.

In order to improve the conditions of safety of life in United States vessels, it is suggested that the question of increased safety in coastwise vessels should be considered by the Department of Commerce on the basis of the Convention, or even on a basis insuring greater safety than contained therein. In order to assist in the application of the Convention requirements, the following suggestions are made:

1. That statutory load line or freeboard legislation should be enacted.

2. That curves of floodable lengths should be constructed and issued by the Department of Commerce for standard types of the United States vessels.

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Widespread interest is now being taken in the United States in the movement to safeguard the traveling public from injuries and loss of life, particularly as regards transportation on land. Safety of life at sea is, however, receiving considerably more attention than in former years, except as regards the possibility of loss of life from fire, and the object of my paper is also to create interest in this important feature of the safety campaign. The greatest degree of safety can be obtained by the use of automatic sprinklers at a small additional expense, the sprinkler system to be constantly under water pressure, so that the supply will be automatic in case of fire.

I have given statistics showing that the loss of life from this source is a serious one and have briefly described several typical fires to illustrate the horror of this greatest of all the many perils of the sea.

In tracing out the history of fire prevention and protection on shipboard, it is evident that these matters have not received as much attention, nor advanced as rapidly, as on land, where statistics show practically no loss of life in factories properly constructed and protected. Similar safeguards are applicable to vessels, but general use of them has not yet begun, evidently due to the increased cost.

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The launching of a great ship is always a matter of interest to the profession, and one of anxiety to those responsible. The experience from an unbroken series of successful launches, backed by the knowledge that every

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Naval Architects Annual Meeting

Upbuilding of the American Merchant Marine Discussed—Safety of Life at Sea and New Developments in Ship Propulsion

The twenty-second annual meeting of the Society of Naval Architects and Marine Engineers was held at the Engineering Societies Building, New York, December 10 and 11. On account of the illness of Colonel Robert M. Thompson, President of the Society, Stevenson Taylor presided at the meeting and read the presidential address.

The annual report of the secretary-treasurer showed the membership of the Society at the close of the annual meeting in 1913 to be 812. During the year five deaths occurred and sixteen members resigned, making the membership on November 1, 1914, 791. At the opening session of the twenty-second annual meeting 38 new members were elected, and before the close of the meeting several other applicants were elected to membership. The financial condition of the society was shown to be in excellent condition, the total resources amounting to $26,440.44 (£5,425) and the total liabilities to $575 (£118), making the society's present worth on October 31, 1914, $25,865.44 (£5,307).

The following deaths were recorded during the year: James G. Winship, Thomas Dolan, Gilbert N. McMillan, George N. Gardiner, Naoji Tomikawa.

Several changes were made in the constitution and by-laws of the society relating chiefly to the election of members of the Council and the management of the society. The following were elected vice-presidents for the term expiring December 31, 1917: W. I. Babcock, Rear Admiral W. L. Capps, Prof. W. F. Durand, Rear Admiral D. W. Taylor. Members of the Council for the term expiring December 31, 1917, were elected as follows: J. E. Denton, D. H. Cox, H. L. Ferguson, Prof. C. H. Peabody, F. L. Du Bosque, Prof. H. L. Sadler, H. S. Grove and H. L. Aldrich.

Rrear Admiral W. L. Capps, former chief constructor, U. S. N., was elected a life member of the society.

An expression of the society's attitude towards the upbuilding of the American merchant marine was made in the following preamble and resolution adopted by the society in the course of the meeting:

Preamble and Resolution Adopted by the Society

"It is beyond dispute that the development of the foreign commerce of a nation such as ours is seriously hampered so long as the carriage of that commerce depends upon the convenience and ability of foreign carriers; nor can it be denied that our nation has been paying tribute to foreign nations to perpetuate such foreign supremacy, to the detriment of individual opportunity and of our established system of wages and conditions of living.

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condition has been investigated and every precaution taken, is not sufficient to entirely banish the thought that there may be some unusual factor for which allowance has not been made. The data for some previous vessel, especially one of corresponding dimensions and weight, are the basis of the launching arrangements adopted for a new vessel; and the great value of such data, when full and reliable, is considered sufficient reason for adding the following notes on the launching of a battleship to the valuable papers on launching already contained in the Transactions of the Society.

The launch of the *Oklahoma* was entirely successful, and the statement of data is presented as showing regular practice, not as an example of novel methods. The arrangement for distributing the pressure at the fore poppets is effective, and is presented as an alternative to the use of crushing-chocks. Checking arrangements were not used. It may be worth noting that the retarding effect of rope stops, as generally used for checking, is greater than the work done in stretching and breaking the stops.

The moving-picture method of observation was successful and is accurate. The arrangement used is fully described in the paper, also a more convenient arrangement recommended for any future observations. Attention is invited especially to the enlarged part of a curve determined photographically, and to the closeness with which the usual stop-watch observations correspond to this curve. The proof of accuracy is the agreement of the distance between stations as determined from the microscope readings from the film, and the known distances apart at which they were located.

The distance the vessel ran beyond the calculated point before pivoting actually occurred is interesting. It is caused mainly by the effect of the wave on the distribution of displacement, and tends to somewhat increase the pressure on the fore poppets when the vessel lifts. The form of wave profile on the ship just before pivoting, also the very small movements just at the start of motion, are suggested as interesting parts of the launching operation for further investigation by the photographic method.

It is not suggested that moving-picture data are desirable for all launches; the curves show that stop-watch observations, carefully made, give reliable information. It is to be noted, however, that dimensions and launching weights change; practices, precautions and other launching conditions change; the kind and quality of materials that must be used change; and it is advisable that launchings be rigidly investigated from time to time and that accurate observations and records be made. Photographic methods offer advantages to that end.

LAUNCHING DATA, U. S. S. OKLAHOMA

Type of vessel	Battleship, First Line
Builders	New York Shipbuilding Co., Camden. N. J.
Date of launch	March 23, 1914

PRINCIPAL DIMENSIONS, ETC.

Length between perpendiculars	575 feet
Breadth on load waterline	95 feet 2½ inches
Mean draft	28 feet 6 inches
Displacement	27,500 tons
Percentage completion at time of launch	61 percent
Weights worked into vessel	11,765 tons
Temporary weights on board	85 tons
Men, tools, and dunnage	115 tons
Launching cradle	470 tons
Total launching weight	12,435 tons
Draft after launching, forward	13 feet 7 inches
Draft after launching, aft	16 feet 4 inches

BUILDING SLIP, LAUNCHING WAYS, CRADLE, ETC.

Declivity of building slip, per foot	11/16 inch
Declivity of keel blocks, per foot	11/16 inch
Length of ground ways over all	644 feet
Length of ground ways submerged	167 feet
Width of ground ways (each)	60 inches
Thickness of ground ways	16 inches
Declivity of ground ways, per foot	11/16 inch
Camber of ground ways	None
Inclination of ground ways, transverse, per foot	⅜ inch
Spread of ground ways, center to center	28 feet 6 inches
Material of ground ways	Yellow pine faced with oak
Length of sliding ways over all	473 feet
Length of sliding ways, effective	465 feet
Thickness of sliding ways	15 inches
Maximum width of sliding ways	58½ inches
Effective width of sliding ways	57 inches
Bearing area	4,420 square feet
Material of sliding ways	Yellow pine faced with oak
Length over which poppets distribute pivoting pressure,	23 feet
Area under poppets to take pivoting pressure,	220 square feet
Projected length of curved bearing surface under fore poppets	21 feet 9 inches
Projected area of trunnion segment to take pivoting pressure	208 square feet
Number of wedges, spaced 17-inch centers	590
Wedges, oak, 9 feet by 6½ inches, tapered ½ inch per foot.	
After end of sliding ways at start, up from water's edge	6 feet
After edge of rudder at start, up from intersection of prolonged keel line and water, about	9 feet
After perpendicular to after poppet bearing on ways,	66 feet
After perpendicular to after poppet bearing on ship,	78 feet
Forward perpendicular to forward end of sliding ways,	44 feet
Forward perpendicular to center of fore poppets	59 feet
Means for distributing pressure at fore poppets,	Rocker formed as a segment of a trunnion

PRESSURE, VELOCITY, COEFFICIENTS, ETC.

Total weight on ground ways	12,435 tons
Initial pressure per square foot	2.82 tons
Maximum pressure per square foot over ground way ends,	5.3 tons
Center of gravity forward of center between perpendiculars	7.9 feet
Distance traveled to calculated pivoting	459 feet
Distance traveled to observed pivoting	569 feet
Distance traveled from calculated pivoting to end of ways	181 feet
Calculated buoyancy at pivoting	8,875 tons
Pressure on fore poppets at pivoting (neglecting buoyancy of packing)	3,090 tons
Pressure per square foot under fore poppets at pivoting	14.05 tons
Pressure per square foot on projected area of trunnion segment at pivoting	14.85 tons
Distance traveled to bring center of gravity over end of ways	410 feet
Depth of water over ends of ways (actual corresponding to 5 feet 10 inches tide)	9 feet 6 inches
Least excess of calculated moment to prevent tipping,	52,200 ton-feet

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Static drop of vessel where poppets leave the end of ground ways .....6 feet 4½ inches
Average velocity first 100 feet (5.8 feet per second), 3.3 knots
Maximum velocity (23.6 feet per second). Nearly 15 knots
Ship hung 2 or 3 seconds and then started slowly without application of rams or other means.
Travel before rudder entered water, about.....25 feet
Travel to point of maximum velocity, about.....100 feet
Time to point of maximum velocity.....17.25 seconds
Travel to point of drop, fore poppet at end of ways, about .....640 feet
Time to point of drop, about.....41.6 seconds
Coefficient of starting (sticking) friction, about....0.0575
Coefficient of friction, average first 50 feet, about...0.026
Coefficient of friction and resistance, average first 100 feet, about 0.016
Coefficient of friction and resistance, minimum, about 0.004
Coefficient of friction and resistance, average after 250 feet run, about.....0.06

MISCELLANEOUS

The recorded weights at time of launch were subsequently confirmed by the observed displacement.

Method of release—hydraulic triggers.

Pressure used for triggers—Started with 250 pounds per square inch and was gradually increased as blocks were removed to a maximum of 1,600 pounds per square inch just before dog shores were dropped.

Temperature on day of launch on building slip, 31 degrees F.

Lubricant on ground ways—Under fore poppets applied several weeks before launching. First a thin coat of stearine, next a 9/16-inch thick coat half tallow, half stearine.

On remainder of ground ways under sliding ways, applied two to three weeks before launching. First a thin coat of stearine, next a mixture of three parts tallow to one part stearine.

Remainder of ground ways to a point 36 feet beyond low water mark, applied by means of cofferdams three to four days before the launch, and touched up the day before on account of damage from ice—Tallow mixed with lard oil.

Lubricant on sliding ways, applied two to three weeks before launching—Forward 80 feet thin coat of stearine, whole length with launching grease smeared on lightly.

Lubricant on pivoting surface under fore poppets—A mixture of half stearine and half tallow applied 9/16-inch thick.

Removing blocks, etc.—Some of the blocks at ends of vessel and most of the shores were removed the day before the launch.

Wedges were set by mauls and alternate keel blocks removed, starting at 7.30 A. M. on day of launch. Rallies on the wedges, using rams, were made at 10.00, 10.11, 10.22 and 10.32 A. M., the last block was out at 12.10 P. M., dog shores dropped at 12.13 and ship released at 12.15 P. M.

About 280 men were employed below the ship; some 40 of these afterward went on board, making about 120 men on the ship at time of launch.

Vessel was launched just as tide was turning ebb; there was a moderate breeze from the southwest.

Stability of Vessels as Affected by Damage Due to Collision

BY WILLIAM GATEWOOD

ABSTRACT

In this paper, the conditions of stability of a coastwise passenger and freight steamship are investigated. The vessel is considered as subdivided in accordance with the rules set forth by the International Convention of 1913-14 as a vessel engaged in a mixed cargo and passenger service, and as damaged by collision opening one compartment to the sea. It is shown that the stability is threatened almost at once, and that, to prevent capsizing, an initial metacentric height of not less than 18 inches is necessary for a vessel of the size considered. Attention is invited to the danger caused by the small freeboard of the tops of the bulkheads, in case of rough weather at time of collision or shortly thereafter.

The Expansion or Contraction of Dimensions and the Effect Upon Resistance

BY PROFESSOR HERBERT C. SADLER

In the preparation of the plans for a new vessel it frequently happens that the designer has at hand the trial data as to speed and power for a vessel, similar, so far as the coefficients of form are concerned, but whose ratios of dimensions are not the same as those of the proposed vessel. From former experience and results of model tests already published, it may be possible to estimate the effect of change in ratios of dimensions with a fair degree of accuracy, but in order to obtain additional data upon this subject and to bring the results into a more concrete form the following investigations were undertaken:

Three different types of ordinary mercantile forms were designed ranging in longitudinal coefficients at the deepest draft from .551 to .674. Each model was tested at three different drafts, but the same actual drafts were used in each case.

A number of models of each type were made of varying breadths, by simply expanding or contracting the parent form in this direction only, the length and draft in each case remaining constant.

In a similar manner the length and breadth were held constant and the under-water form changed by varying the distance between the original waterlines only—i. e., expanding or contracting the draft. Also, the breadth and draft were kept constant and a series of models made by expanding or contracting the distance between the transverse stations—i. e., expanding or contracting the length.

Finally, the three forms were tried of the same displacement, breadth and draft, but of different lengths and hence different coefficients of form.

The coefficient of midship section was kept constant throughout the series.

In all of the foregoing, therefore, the displacement for each type was allowed to vary in the same ratio as the variation of the particular dimension.

The particulars of the three types are given in the following table:

Draft.	Type 1.			Type 2.			Type 3.		
	C_m	C_1	C_b	C_m	C_1	C_b	C_m	C_1	C_b
a.....	.936	.674	.63	.936	.606	.567	.936	.551	.515
b.....	.92	.665	.612	.92	.598	.537	.92	.544	.501
c.....	.904	.648	.585	.904	.583	.526	.904	.530	.479

The varying ratios of length and breadth and draft are shown on the respective curves.

The curves of sectional areas of the parent forms are shown in Fig. 1, and represent the three different types of varying length and constant displacement. In presenting the results of the experiments it has been deemed advisable to give them in the form of wave-making resistance per ton of displacement, in terms of speed-length ratio. For any particular case the surface friction is readily calculated, and although when total resistance is con-

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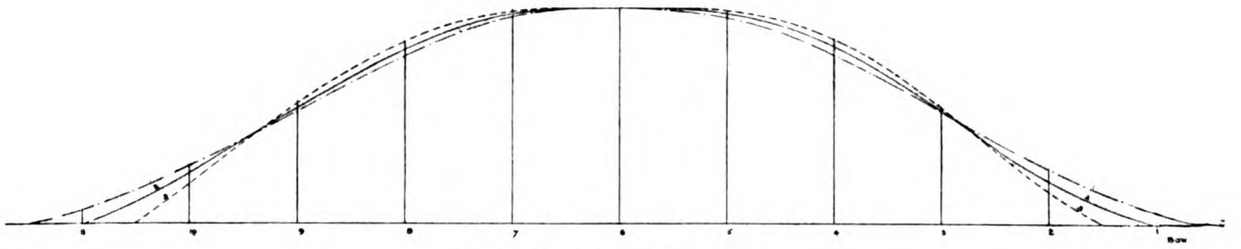

Fig. 1.—Curves of Sectional Areas

sidered the results may appear different from those due to wave resistance only, it is the latter which is usually the unknown quantity. The fact that the residuary resistance is obtained by subtracting the frictional from the total resistance, together with possible minor experimental errors, would probably account for certain inconsistencies which appeared in the final results. In general, however, within the limits of economical speed for each type, or before the region of the first "hump" in the resistance curve, the results were fairly consistent, and the following curves represent the average variation in each case. Beyond the above speeds the variation in resistance did not seem to follow any simple law but varied somewhat with the speed.

The curves shown in Fig. 2 represent in general the variation of residuary resistance per ton of displacement with respect to breadth. They are the results for the medium draft (b) for each type, but the same characteristics were found to hold for the other drafts at which the models were tried.

Within the limits of the variation of breadth shown, the residuary resistance appears to vary as about the 1.65 to the 1.7 power of the breadth, or the residuary resistance per ton of displacement as about the .65 to .70 power of the breadth, if the lines are simply expanded or contracted and the displacement allowed to vary accordingly.

The effect of variation of draft due to expanding or contracting the dimension in this direction, did not appear

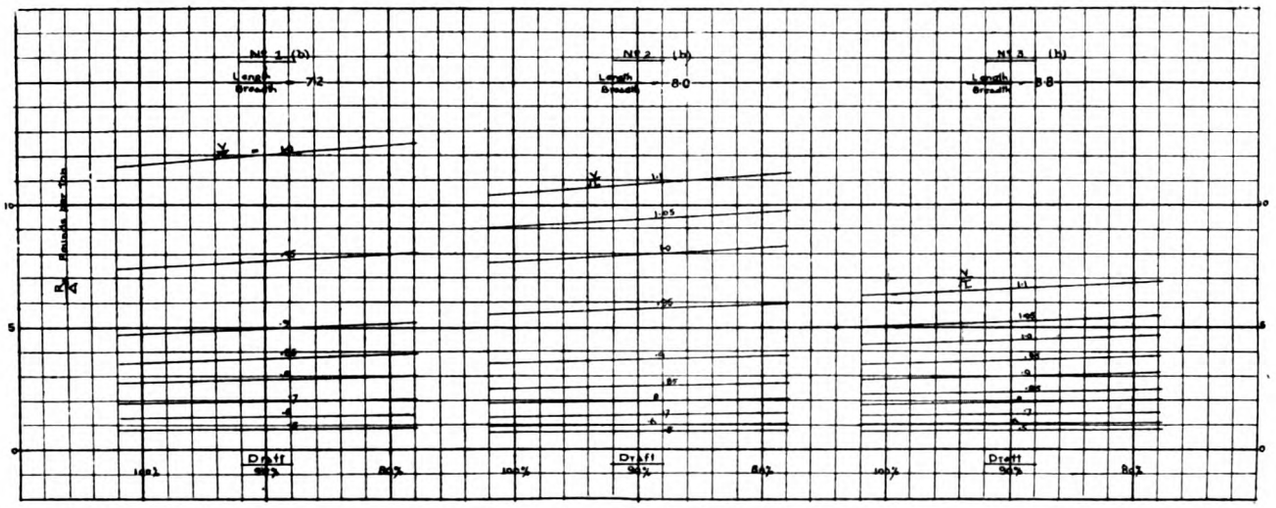

Fig. 2

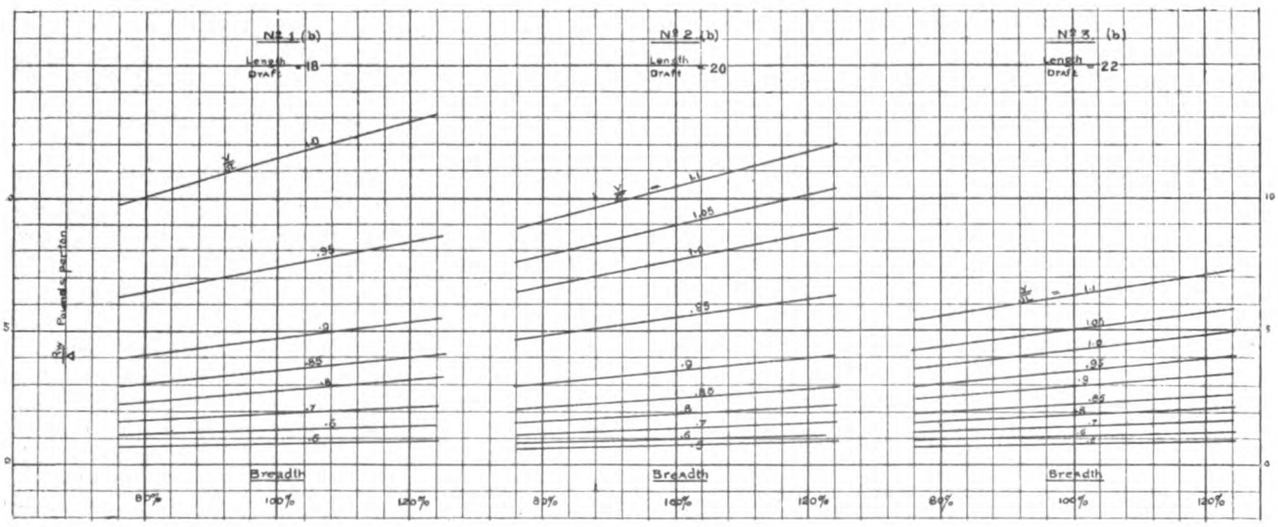

Fig. 3

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to be quite as consistent as in the previous case, but in general the average results are shown in Fig. 3. They are for the forms represented by the medium draft (*b*). Up to the limit of economical speed the residuary resistance varies as about the .65 to .7 power of the draft. Above these speeds the index gradually increases. The residuary resistance per ton of displacement therefore varies inversely as about the .35 to the .3 power of the draft.

As a check upon this, each of the forms was expanded or contracted longitudinally, and the results are shown for the medium draft (*b*) in Fig. 4. If the length be increased, say, *n* times, breadth and draft remaining constant, we obtain a similar form to that of the parent type in which the breadth and draft have each been reduced *n* times; and therefore if the residuary resistance per ton of displacement at corresponding speeds varies as the .7 power of the beam and inversely as the .3 power of the draft, the combined result would be that this factor will vary as $n^{.7} \div n^{.7}$ or $\frac{1}{n^{.4}}$. In other words, the residuary resistance per ton at constant speed-length ratio will vary approximately inversely as the (length)$^{-.4}$. An examination of the above curves, Fig. 4, will show that this is practically the case.

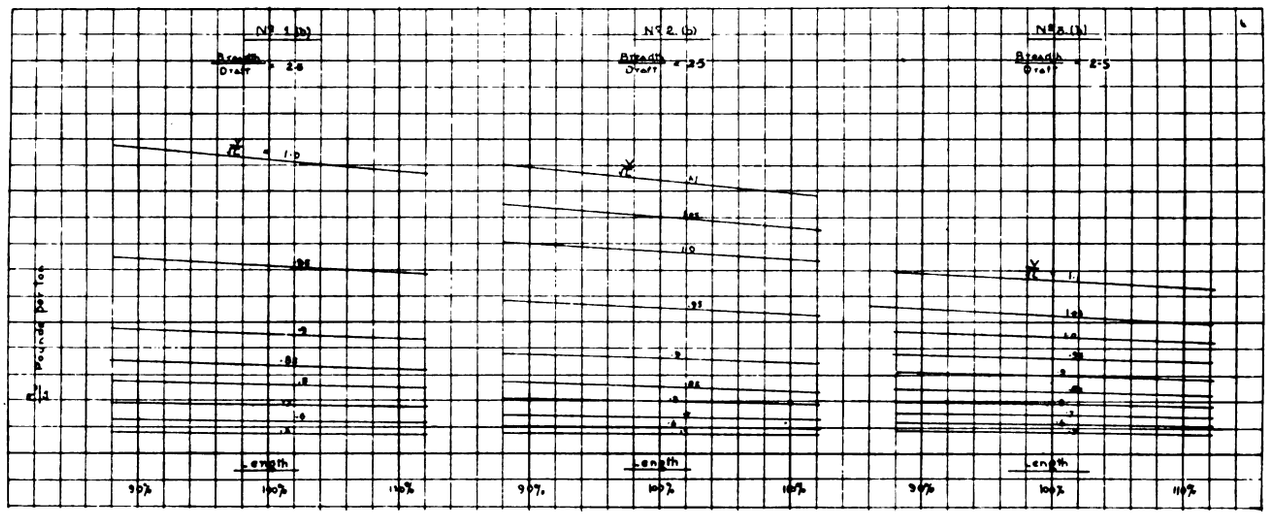

Fig. 4

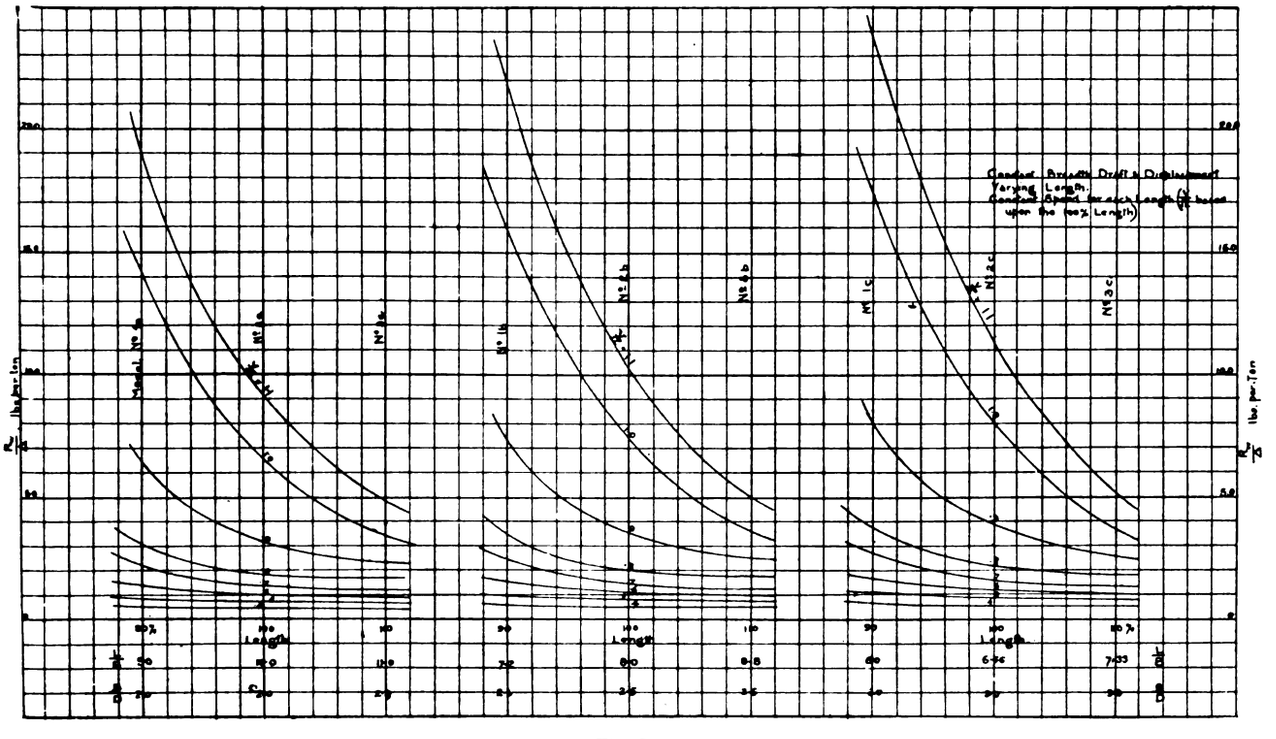

Fig. 5

Effect of Varying Length Only

If length alone is varied, breadth and draft being kept constant, we have simply a combination of the foregoing; for if all dimensions were varied proportionately the residuary resistance per ton of displacement would be constant at constant speed-length ratios. Increasing, say, the length only is therefore equivalent to reducing both breadth and draft of the parent form simultaneously.

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As the three original parent forms were made of the same displacement but of different lengths, the effect of influence of length for this particular series could be readily obtained. The curves, Fig. 5, show the results for the three different drafts at which the models were tried. They represent constant speed curves for varying lengths with constant beam, draft and displacement, and illustrate the well-known influence of length as affecting residuary resistance. The total resistance curves would not, of course, show such a marked difference, as the longer form, though finer, would have a greater friction than the shorter and fuller form.

Shallow-Draft Types

In connection with some experiments upon certain types of river steamers, such as those of the Mississippi stern-wheel type, occasion was had to determine the effect of variation of breadth only. These are rather extreme types where the ratio of length to draft was from 40 to 50 and the ratio of breadth to draft varied from about 8 to 12. Two different types were tried, the stern in both cases being that usually adopted for the stern-wheel vessel, and the bows either ship-shape or "scow" form.

In these cases the wave-making resistance at corresponding speeds, within the limits of speed at which these vessels would normally be run, appears to vary as about the .75 power of the beam, or per ton of displacement inversely as the .25 power of the beam.

As the models of the above contained a large percentage of parallel middle body, this part, which represents a practically rectangular form, was also tried at different breadths. The ratio of breadth to draft was the same as for the previous forms, but in this case the residuary resistance appeared to vary directly as the beam, or the residuary resistance per ton of displacement was constant at corresponding speeds.

In conclusion, a word of caution should be given about extending the above results beyond the limits of the experiments, both with regard to dimensions and speed. Within these limits of, say, 20 percent variation no serious error will be involved if the residuary resistance per ton of displacement at constant speed-length ratios be assumed to vary as about the .7 power of the breadth, inversely as the .3 power of the draft, and inversely as the .4 power of the length; or the residuary resistance be assumed to vary as the 1.7 power of the breadth and as the .7 power of the draft, and .6 power of the length, for similar normal mercantile types at corresponding speeds.

The results also emphasize the fact that the draft is the more economical dimension to increase, if increased displacement of a given type is desired.

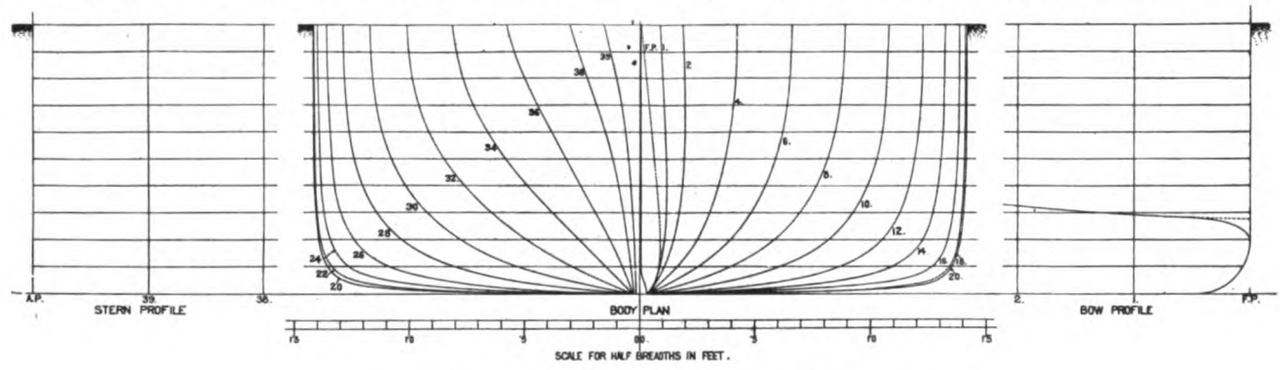
For very wide and shallow forms, however, the influence of breadth upon residuary resistance does not appear to be as marked as in the case of the more normal forms.

Some Experiments with Models Having Radical Variations of After Sections

BY NAVAL CONSTRUCTOR D. W. TAYLOR, U. S. N.

When we determine the form of a ship there are two things which must be done in connection with every station or section. We must, by some means, fix the area and then determine the form or shape to be given the section having the given area. Taking ships as they are, for given dimensions and displacement there is not room for very large optional variations of sectional area except near the extremities. The designer has a fairly free hand, however, when it comes to the shapes of the sections, particularly toward the extremities.

There are, of course, matters to be considered in connection with these shapes other than the question of resistance, such as seaworthiness, carrying capacity, etc., but it should be understood that in this paper questions of resistance only are taken up. Broadly speaking, as regards the shape of sections, the accepted practice is to approach the U-type forward and the V-type aft. From our experience at the U. S. Model Basin this practice, as regards resistance, would appear fully justified as to the bow, the U-type of section being nearly always desirable



Stern A. Body Plan, Bow and Stern Profiles

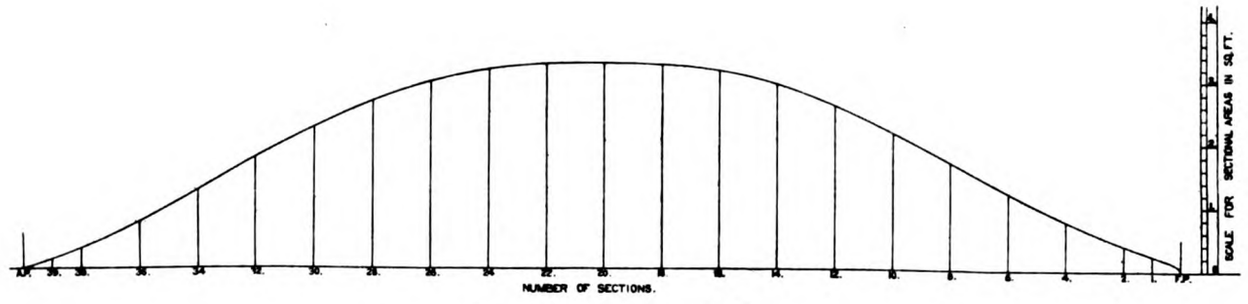


Fig. 1.—Curve of Sectional Areas

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forward. Moreover, the resistance seems to be more affected by changes forward than by the changes aft, or, to put it in another way, to depend more upon the forward than upon the after form.

Systematic variations of form of entrance generally result in systematically varying resistance and allow definite conclusions to be drawn. When it comes to the run, however, we find it much harder to draw definite conclusions. Changes in the form of the after sections appear to affect the resistance less than do changes forward, and changes of resistance for systematic changes of after form are not always systematic. So, while we feel that the standard practice is probably right and that V-sections aft are desirable from the point of view of resistance, we do not feel that here we are upon such firm ground as with regard to the U-sections forward.

In view of the difficulty of obtaining definite characteristic results from comparatively small changes of shape aft, we have recently made some experiments with after forms of radically differing shapes, and it is the object of this paper to put before the Society the results obtained.

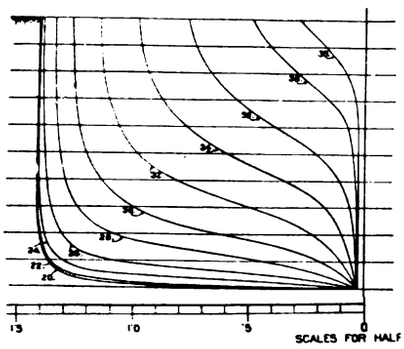

Fig. 2.—Stern B

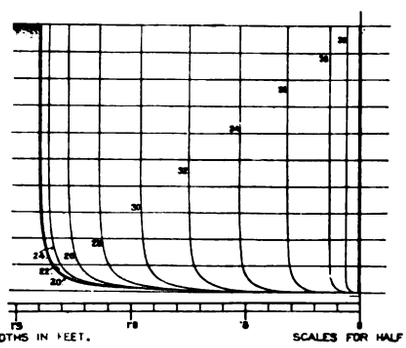

Fig. 3.—Stern C

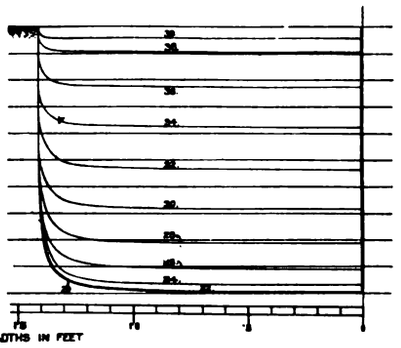

Fig. 4.—Stern D

Six after bodies were tested for resistance, all with the same fore body and all having the same curve of sectional areas. All models were 20 feet long in accordance with the standard practice at the U. S. Model Basin. The beam was 1,828 feet; draft, 1,179 feet; displacement, 2,500 pounds in fresh water; midship section coefficient, .98; longitudinal coefficient, .6122; block coefficient, .60.

Fig. 1 shows the original lines, including stern A and the curve of the sectional areas for all models. This was one of the models tested last year, the results being included in my paper of last year on "Relative Resistance of Some Models with Block Coefficient Constant and other Coefficients Varied." Sterns B, C, D, E and F are shown in Figs. 2, 3, 4, 5 and 6. Fig. 7 shows the curves of total resistance and the estimated wetted surface resistances, and Fig. 8 shows the residuary resistances.

The underlying idea of stern B was a shape which would start the water up more quickly than in the standard type. The idea of stern C was to carry right aft sections derived from the midship ssection (98 percent coefficient) beam only being decreased; in other words, to make a wall-sided model. Stern D was stern C disposed horizontally instead of vertically. The beam was kept constant and draft only was changed, as we went aft, the sections having 98 percent coefficient. In other words, stern D was an exaggeration of the flat-stern type.

Stern E was a combination of sterns C and D, the attempt being made to combine them half and half, as it were, and coax the water up along a bilge diagonal. In stern F not only was the coefficient .98 retained for all sections, but they were made geometrically similar to the midship section, beam and draft both being decreased as necessary to obtain the required area. For sterns C, D and F the sectional coefficient is constant—.98, as already stated.

Fig. 9 shows how this constant sectional coefficient contrasts with the curves of sectional coefficient of A, B and E. It is typical of V-sections that the sectional coefficients are below .5, but when we consider that in the conventional type the after sections include actual or virtual dead wood, it is evident that the numerical value of a sectional coefficient aft has small significance as indicating the nature of the form with which the water has to deal.

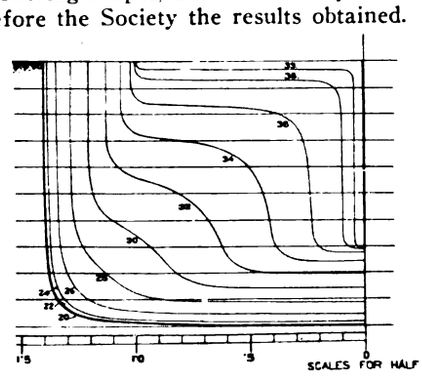

Fig. 5.—Stern E

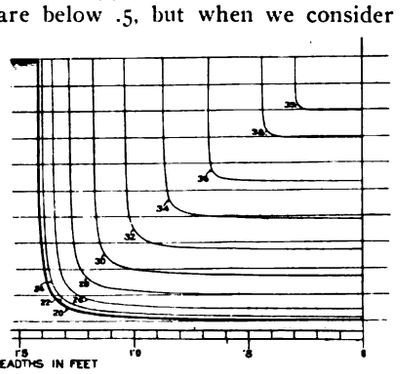

Fig. 6.—Stern F

The outstanding result of the experiments was the good showing of stern F. Of course this was partly due to small wetted surface, but stern F shows up very well in the curves of residuary resistance, indicating that even with a conventional dead wood added it would still be somewhat the best.

Stern D, the exaggerated flat stern, undoubtedly makes the worst showing in Figs. 7 and 8, which is at first sight surprising in view of the fact that the wide, flat stern is used with success on many fast boats. But the wide, flat stern as used is usually of a type somewhere between D and F, and Figs. 7 and 8 do not go up to torpedo-boat speed. For 20-foot models torpedo-craft speeds correspond to 8

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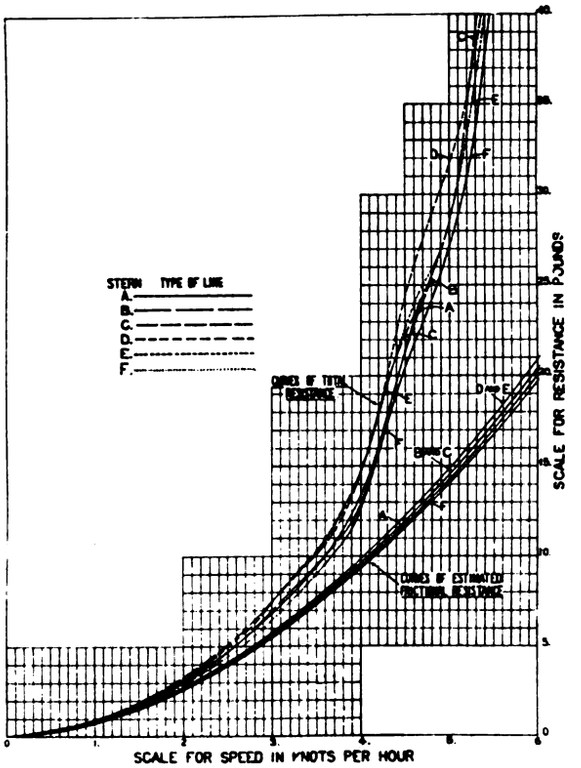

Fig. 7.—Curves of Total Resistance

knots or more, and it is quite possible that at 8 knots stern D would show the least resistance. The models used were not of high-speed type, having four or five times as much displacement for a given length as a high-speed torpero-boat model, and hence were not tested to high speeds. It is interesting to note that the excessive resistance of stern D at speeds a little below five knots is really due to a characteristic favorable to high speed. The virtual or effective length of model D is greater than that of the others and, when the curves of the others are past the 4½-knot hump and drop down into the succeeding hollow curve, D is still on the hump.

Other conclusions might be drawn from the curves, but

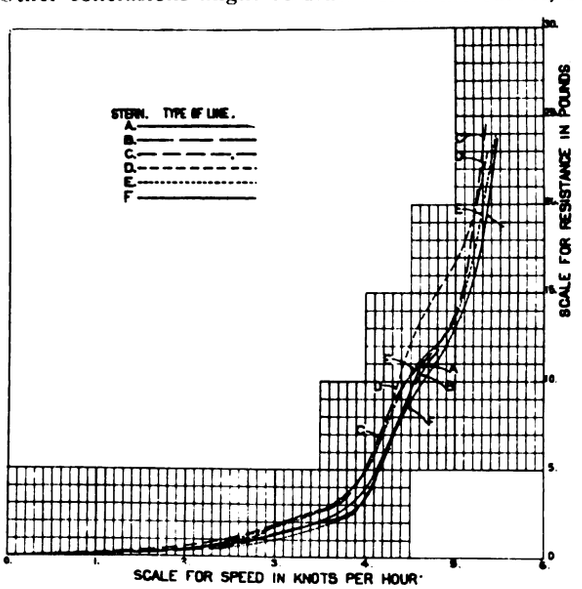

Fig. 8.—Curves of Residuary Resistance

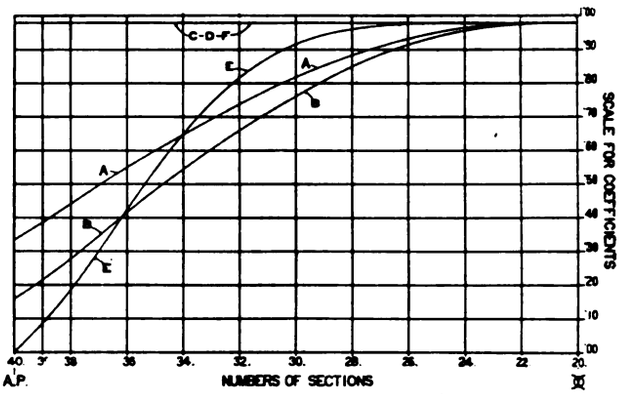

Fig. 9.—Curves of Sectional Coefficients

it would not be safe to generalize from a few results. Bearing in mind that a ship of the displacement length coefficient involved would not be powered in practice for speeds above 4 knots, the results appear to indicate that gain could be made at practical speeds by departing from the conventional type of after body, but that they would be comparatively small, after all. They would be of the 5 percent order, not 15 or 20 percent.

Recent Development in Submarine Signaling

BY J. B. MILLET

ABSTRACT

The system of sending warning signals under water from shore to ship or from ship to ship has now been accepted and put in operation throughout the world. There are in all nearly 200 signal stations in operation to-day which may be used by ships approaching in fog or thick weather. Nearly all the large shipping companies in the world have one or more ships installed with a receiving apparatus which enables them to locate their position by listening and ascertaining the direction through the submarine bells, which are operated as a part of the lighthouse service of the various countries. Over 1,200 vessels are equipped with a receiving apparatus and a proper notation is now placed against all vessels so equipped in Lloyd's "Register of British and Foreign Shipping," "Record of American and Foreign Shipping," "Bureau Veritas" and the "Germanischer Lloyd."

Within a short time an apparatus has been invented by Prof. Reginald Fessenden, called the "oscillator," which consists briefly of a heavy diaphragm operated under water by means of electric current, and which can be used for sending signals by the Morse alphabet. This apparatus has been used successfully in detecting the presence of icebergs by sending sound through the water and then ascertaining the direction from which the echo comes. Signals sent by this oscillator have been distinctly heard at a distance of 30 miles. Battleships, transatlantic steamers, and all other large vessels, if equipped with the oscillator, are therefore afforded a means of intercommunication. Since the oscillator is not only a transmitter of sound but a good receiver of sound, it serves a double use. If submarine boats are equipped with the oscillator, they should be enabled, without much difficulty, to detect the presence of any vessels which they wish to strike, by listening to the sounds which are inevitable on any large steamer. It would therefore follow that a submarine boat could detect the presence of its mark when several miles off, and without using its periscope it could make its attack. It could also communicate with its headquarters and receive and give any messages that are desired. It is,

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therefore, seen that this invention should add greatly to the efficiency of a submarine boat, as it has already added greatly to the safety of ships at sea.

The Thermodynamics of the Marine Engine

BY JOHN F. WENTWORTH

ABSTRACT

It is the contention of the writer that there is no real Diesel type engine in use to-day. The contention is that the present engines owe their value and efficiency to the same principles which govern the gas or so-called explosion engines. Any gain in efficiency in the present oil engines due to the use of high-pressure of compression is more than offset by disadvantages resulting from this same high-pressure of compression. If this be not so why are not gas engines run on the so-called Diesel principle? It is possible to inject a blast of gas into the cylinder at the end of compression obtaining the same results now obtained in the engine built under the so-called Diesel principle.

A diagram is given, showing how the temperature rises very rapidly during the period of injection and in a manner contrary to the Diesel theory. It is owing to this divergence from the Diesel theory that the Diesel engine is a commercial success. Indicator cards and also temperature curves for various engines are also given. These data accentuate the contention that the Diesel engine is nothing but an explosion engine modified, as it must be, to use as a non-volatile oil.

Attention is called to the fact that injection air need not be cooled and should not be cooled, at least to the present extent. The energy of a pound of air at room pressure and temperature is the same as the energy of the same weight of air after it has been compressed to 1,000 pounds pressure and cooled to room temperature. If the energy depends upon the temperature and not upon the pressure, then it behooves us to refrain from unnecessary cooling of the injection air.

A set of curves is given for determining the pressure of compression needed to assure ignition with the temperature at the beginning of compression known. If the exponential curve based on 1.405 for an exponent is correct for the adiabatic compression of atmospheric air, then this set of curves will give the nearest result. If a different exponent be used the result will be correct at one point and one point only. The error in the curve based on 1.405 lies in the effect of radiation. In a warm cylinder air takes up heat at the beginning of compression and gives heat up at the end of compression. By using an exponent of 1.35 or 1.30 curves will be obtained which will cross the real curve (if there be sufficient radiation loss). This point of intersection will be the only correct spot on the artificial curves, and there is no means for knowing where this point will be.

Cards taken from the writer's experimental engine are also given. When taken these cards were considered as failures for the most part. A collection of these cards, however, tends to prove that which the writer has contended for years, namely, that the so-called explosion engine is limited in its efficiency by the fact that its pressure of compression is restricted to a maximum level. The Diesel engine is limited in its pressure of compression to a minimum level. Perhaps the ideal condition lies somewhere between the two conditions. A method of governing is proposed by the writer by means of which the friction loss in the main bearing should be reduced very materially.

In an ideal thermodynamic system suggested by the writer there is no loss of heat units in the plant from the time of combustion in the cylinder till the exhaust gases leave the economizing boiler and the spent steam is condensed in the condensers except the accidental radiation. This modification in the oil engine not alone gives a greater efficiency, but makes a far more perfect engine. By means of the hot jacket the engine can run at a much slower speed, and also extreme pressures can be avoided giving an increase in efficiency and enabling the weight of the engine to be reduced.

Refueling Warships at Sea

BY SPENCER MILLER

ABSTRACT

Mr. Miller's paper indicates the value of mastering the art of refueling warships on the high seas. The British blockade in the North Sea has proved that blockades are not obsolete. Of the hundred coal-burning cruisers said to be patroling the North Sea, probably fifteen are frequently, if not continuously, absent from patrol service, filling their coal bunkers in English harbors or English roadsteads. Every cruiser retired from the patroling line to replenish its coal bunkers materially weakens the patroling fleet, for the absent ship is temporarily useless for fighting purposes. While in the blockade of Charleston, during our Civil War, not more than 75 percent of the blockading ships were continuously on duty, Mr. Miller admits, for purpose of illustration, that the efficiency of the British patrol may be as high as 85 percent. Fifteen British cruisers continuously absent from patrol duty represents a loss of $30,000,000 (£6,160,000) worth of ships from service. Such a blockade can be maintained at nearly 100 percent efficiency when able to replenish their bunkers at sea.

The triumph of the submarine has modified blockading methods. To be safe from submarine attack cruisers must steam ahead at not less than 10 knots. Any attempt to coal broadside while steaming at 10 knots would be attended with great difficulties, unless the sea be smooth. Even if coaling broadside under a 10-knot headway at sea be permissible while steaming head on into the sea, it would be attended with great danger if a zigzag course was taken, which would throw both ships at times into the trough of the sea.

None appreciates the value of refueling warships at sea more than the British Admiralty. Their experiments to find or develop suitable coaling at sea apparatus have covered a period of years and the expenditure of hundreds of thousands of dollars. The British Admiralty own but one collier. Colliers carrying coal for British warships are privately owned and chartered as required. The British Admiralty have mastered the art of oil bunkering under headway in smooth seas. Great Britain's fastest cruisers, protecting English ships on the Atlantic Ocean, doubtless are absent from the lanes of travel from 15 to 25 percent of their time, coaling at Halifax or Bermuda.

The German Admiralty have devoted several years developing and testing out at least two cableway systems for coaling cruisers on the high seas. The Adam system adopted by Germany has been most successful. The German Admiralty required an apparatus to be carried wholly by the cruiser and capable of taking coal from captured merchantmen on the high seas at the rate of 50 tons per hour. The German cruiser *Roon* was known to have been equipped. The manufacturers of the Adam system were

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commanded not to disclose the names of the cruisers equipped with the apparatus, nor even the number of such apparatus installed upon cruisers.

The European war has shown how easy commerce destroyers can replenish their coal supply from captured ships and how thoroughly the German cruisers have been supplied with coal in various quarters of the globe. Many incidents connected with the war indicate that the high seas is an extremely safe place for vessels to hide, especially if they use their wireless to listen but never to talk.

The Japanese battleship *Hizen* is reported to have arrived at Honolulu fully coaled and provisioned, 14 days from Japan. The *Hizen* was formerly the Russian battleship *Retvizan*, built by the Cramps and equipped with a marine cableway, described in a paper read before this Society in 1904.

In 1903 few of our ships coaled faster than 30 tons per hour alongside in harbors. This spring the U. S. S. *Wyoming* took on 2,100 tons of coal in five hours from two colliers in Guantanamo Bay. The collied *Jason*, equipped with marine transfers, described before this Society in 1910, delivered a maximum of 465 tons in one hour, and delivered 1,040 tons in three working hours. The U. S. Navy leads in large colliers and improved appliances for coaling broadside in smooth waters, as well as in marine cableways coaling warships in tow under headway on the high seas.

The marine cableway on the U. S. collier *Cyclops* is the outcome of study and experiments covering a period of twenty-one years. It is operated by three automatic tension engines, a new marine implement. The automatic tension engine contains a noval form of tension governor whereby the slightest change in the tension of the suspended cable produces a corresponding and proportionate change in the steam pressure. A slackening of the suspended cable produces an instant raise in the steam pressure sufficient to restore the tension to normal. A tightening of the suspended cable produces an instant reduction of the steam pressure, permitting the cable to pay out until the tension is restored to normal. The governor is extremely sensitive to the tension in the supporting lines, maintaining them practically uniform at all times. Loads up to 4,000 pounds are picked up from the deck of the collier, transported about 500 feet and dropped on the deck of the warship at intervals averaging one minute and six seconds; frequently at intervals of 50 seconds.

The marine cableway on the collier *Cyclops* has met the most exacting requirements of the Navy Department, there being no demand for any improvements or changes in the apparatus. It has been tested in heavy seas with the huge collier *Cyclops* rolling 20 degrees. On another occasion coaling was carried on between the collier *Vestal* and the battleship *Virginia* in a dense fog in which neither ship could see any part of the other.

An earlier form of marine cableway, tested by Great Britain, was successful in coaling the battleship *Trafalgar* in half a gale of wind. In Italy the third-class cruiser *Liguria*, 2,280 tons, received 60 tons of coal per hour in a sea so rough that the screws of the cruiser were frequently seen from the collier *Sterope* in tow.

Fighting ships of the U. S. Navy, omitting destroyers and submarines, comprise 67 coal-burning ships and 3 oil-burning ships. In future, whether these ships serve for blockading purposes, or whether steaming at a distance for a foreign coast, they could remain continuously with the fleet, coaling broadside when the sea was smooth and with the marine cableway in anything short of a very rough sea, while steaming at the speed of the fleet or the patrol.

Our First Frigates—Some Unpublished Facts About Their Construction

BY HON. FRANKLIN D. ROOSEVELT
Assistant Secretary of the Navy

ABSTRACT

The present navy of the United States had its origin in the act of Congress of 1794, which authorized the building of six frigates, four of which were to carry 44 guns and two to carry 36 guns each. The appropriation made available was $688,888.82. The principal dimensions of the frigates are as follows:

44-*Gun Frigates.*—Length of gun deck from rabbit of stem to post, 174 feet 10½ inches; length of keel, 145 feet; molded breadth of beam in the extreme part, 43 feet 6 inches; height of wing transom above rabbit of the keel, 25 feet 8½ inches; height of lower deck transom above rabbit of keel, 20 feet 9 inches; height between gun deck and lower deck, 6 feet 4 inches.

36-*Gun Frigates.*—Length of gun deck from rabbit of stem to post, 163 feet 7 inches; length of keel, 136 feet; molded breadth of beam in extreme part, 40 feet; height of wing transom above rabbit of keel, 24 feet; height of lower deck transom above rabbit of keel, 19 feet 2 inches; height between gun deck and lower deck, 6 feet.

Various features connected with the building of these ships, including the difficulties encountered and the added appropriations needed for their completion, are given in this paper taken from early records of the Navy Department which were hitherto unpublished. Special reference is made to the frigates *United States, Constitution* and *Constellation*. Their records throughout the years have been a monument to the men who planned them, the men who built them, and the men who manned them. All of them became victors in battle—the *Constellation* in actions against the French frigates *Vengeance* and *Insurgente;* the *United States* in the victory over the British *Macedonian*, and the *Constitution* in the capture of the British *Guerriere, Java, Cyane* and *Levant*. Two of the three, the *Constitution* and the *Constellation*, are proudly carried on the rolls of the United States Navy to-day, 117 years after their launching.

The Behavior of Riveted Joints Under Stresses

BY JAMES E. HOWARD

ABSTRACT

Unit values of the component parts on which the computations of strength of riveted joints are based are not held to be fixed values as commonly assumed. A reinforcement in strength of the net section occurs, a variable factor which reaches its maximum in close pitched work, diminishing as the pitch increased, and eventually having a negative value in wide pitched multiple riveted joints. Over a certain range of pitches the ratio of net to gross section of plate may be practically compensated for by this reinforcement, thus resulting in joints of different pitches having substantially identical efficiencies.

The ultimate strength of a joint, however, is not regarded as an index of endurance to repeated stresses; that the elastic behavior of the joint must be considered in such cases. That a good distribution of stresses in riveted construction is not always attained. While certain joints of considerable strength, and high efficiencies, possess a degree of rigidity comparable to that of the solid plate at low stresses, nevertheless, under loads ranging from 15,000 to 25,000 pounds per square inch the extension of the joints is greatly increased over that of the solid plate.

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That frictional resistance contributes its share in the rigidity of joints. In order to secure maximum frictional effects from the contraction of the rivets in cooling, the plates should be firmly held together until the rivet has nearly cooled, a requirement obviously militating against rapid driving, but necessary for the best work. Cover plates and splice plates do not immediately take up the full stresses. A progressive gain or transfer of load goes on for several rows of rivets. Chain riveting gives a favorable impression from the behavior of such joints while under test. Staggered riveting not infrequently fails by a zigzag line of fracture, the rivets in adjacent rows in some cases being so located as to favor this method of fracture. The rigidity of joints in actual construction is not held to be greater, but probably less than that witnessed in laboratory tests.

Riveted joints tested at higher temperatures showed strength similar to that of plain bars at corresponding temperatures. Joints tested at 500 degrees F. showed a maximum gain of 27.6 percent over joints of the same dimensions which were tested at usual atmospheric temperatures. On the net section of the plate the gain in strength due to this higher temperature was nearly 40 percent.

Joints which were strained hot and subsequently tested to destruction when cold were found to have retained the increased strength which they had at the higher temperature. The zone of maximum strength was in the vicinity of 500 degrees F. There was no decided loss in ductility of the joints at the higher temperatures at which they were tested.

The Applicability of Electrical Propulsion to Battleships, Together with the Experience Gained with it on the Jupiter

BY LIEUTENANT S. M. ROBINSON, U. S. N.

ABSTRACT

The object of this paper is to show the best method of ship propulsion to be applied to battleships. It has been attempted to keep out all matters that do not bear directly on this one point. The *Jupiter* has been introduced merely to show the reliability of the apparatus that it is proposed to use. The Navy Department has authorized an electrical installation for the new battleship *California*, and it is believed that she will mark the beginning of a new era in marine engineering.

Briefly, the machinery for a battleship would consist of two turbo-generators running at a maximum speed of about 2,000 revolutions and generating current at about 3,000 volts, two switchboards, and four induction motors. The latter would be arranged with one on each of four shafts. The motors would be of the double squirrel cage type and the stators would be fitted with pole-changers which would give the motors two different numbers of poles and consequently two speed reductions. The motors would have two independent squirrel cage windings, the outer one having conductors of high resistance and the inner one conductors of low resistance. At high frequencies, such as would obtain in the rotor when starting up or backing, the inner winding takes practically no current due to its high resistance under these conditions; therefore the high resistance winding on the outside is the only one in operation and this insures a large torque for starting or backing. When running close to synchronous speed, the resistance of the inner winding is much reduced and it then operates like any ordinary squirrel-cage motor.

In choosing a method of propulsion for battleships, there are six points to be considered. They are, in order of their importance: (1) Reliability, (2) maneuvering qualities, (3) economy, (4) space occupied, (5) weight, (6) care and upkeep.

RELIABILITY

Taking these points in their order, the first to be considered would be reliability. The reliability of induction motors and large high speed turbo-generators for land use has been well known for some time, but up to about one and one-half years ago had not been demonstrated on board ship. However, experience at sea with them has not developed any trouble, and their reliability is now unquestioned. There are several things that go to make an electric installation more reliable than any other. First, the installation is in duplicate throughout and the breaking down of one engine does not affect the ship except at high speed; it might be said that this is true of other installations, but it is not true in the same sense nor in the same degree that it is with the electric drive. For example, if one turbo-generator breaks down, the ship can still run in a perfectly normal manner up to a speed of about 19 knots. This would be impossible with any other mode of propulsion; even at speeds within the power of one engine on a twin screw ship the maneuvering qualities would become so bad as to handicap the ship: in fact, a twin screw ship operating with one engine would be able to reach port safely but would be of very little use in battle, whereas an electrically-driven ship, operating with one turbine, would be just as good as any ship up to a speed of about 19 knots.

Then, too, there is the question of auxiliaries; with other forms of propulsion, if the auxiliaries in one engine-room break down, that engine-room may be almost entirely put out of commission. Of course the main air and circulating pumps are cross-connected, but when operating that way they are not very satisfactory and I have seen a battleship forced to stop because the forced lubrication pumps in the starboard engine-room broke down. If the ship had gone ahead with the port turbines, the starboard turbines would have revolved and burned out the bearings, so that it was necessary to stop the ship and repair pumps; with electric drive it would be a simple matter to shift to the other engine-room and make repairs without stopping.

There is one thing that makes the installation more reliable than other forms of turbine drive, and that is the fact that the turbine revolves in the same direction all the time. The importance of this cannot be overestimated, as it is believed by operating engineers that the greater amount of blading trouble that ships have had is nearly always due to the distortion that occurs when backing. There is also one other advantage when compared with reciprocating engines, and that is that the turbines would be less susceptible to damage by water when the boilers are priming. This fact has been thoroughly demonstrated by experience on the *Jupiter*.

MANEUVERING

As regards maneuvering qualities, it is believed that the electric drive is far superior to any other method. This point will be taken up more in detail when the *Jupiter's* installation is discussed. It is rather difficult to describe these advantages on paper, but very easy to appreciate when you see the machinery working. Instead of big heavy throttles to open and close, there are light, easily handled oil switches, and a speed controller that can be handled with one finger. The engine-room watch required for a battleship would be just half what it would

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be with other means of propulsion, as one engine-room would be idle practically all the time. In a rough sea there is no racing, with its attendant strains on machinery and on the personnel on watch. Any desired speed can be very quickly attained. The speed can be very accurately maintained and without any effort on the part of the personnel. These last two points are of very great importance on battleships when maneuvering in formation. The stand-by qualities are also superior to those of other installations, for at a very small expense in the way of steam the main turbine can be kept running very slowly

Fig. 1.—4,000 K. W. Turbine, *U. S. S. Jupiter*

and the engine-room is then ready to answer signals at any time; this might be of great importance to a battleship. The backing qualities of this installation are also superior to other forms, particularly turbine installations. It is possible to attain full power in the astern direction.

Economy

In considering the question of economy, we have reached the point which first suggested the use of electricity for the purpose of propulsion. None of the older forms of propulsion, such as reciprocating engines or direct connected turbines, can compare at all favorably with this method, the gain in economy being over 20 percent at high and cruising speeds. The only other method of propulsion that would appear to compete with this method in economy would seem to be the combination of high-speed turbines and reduction gears. The loss in the latter amounts to about 2 percent, while in the electric reduction gear the losses are from 8 to 9 percent. Mechanical reduction gears have been developed to a high degree, and it is very probable that in quite a number of cases the mechanical gears would be preferable to the electric drive, but as this paper is limited to a discussion of battleships that subject will not be touched.

For battleships I do not believe there is any question of the relative economy of the two methods—the electric drive is far superior. The electric reduction method possesses two inherent advantages that the mechanical method cannot overcome. First, the electric installation uses only one turbine at low powers; second, the induction motors are fitted with pole changers which allow the turbine to be run at normal speed with the ship cruising at low speed—in other words, the electric drive permits of two speed reductions while the mechanical gear has only one. These two advantages exist no matter how the two installations may be laid out, and they far outweigh the difference in the losses of the two methods. To show just how great these advantages are, two curves are shown. Fig. 1 shows the *Jupiter's* turbine operating under varying loads and Fig. 2 shows the turbine operating under varying speeds (and also loads). The load curve does not really show how very bad the conditions are for a battleship, as in that case the power at 12 knots is only about one-seventh what it is at 21 knots and the curve shown does not give so great a percent of reduction. It will also be seen that the speed curve is very steep at the low speeds and shows the bad effect of reducing turbine speed very greatly. As nearly all the cruising of a battleship is done at fairly low speeds, it is evident that the electric drive will be more economical than the mechanical gear.

In addition to the two advantages just stated, there are a number of other things entering into a comparison of the two methods that make it very doubtful if the mechanical gear would be as good, even at the high speeds, as the electric reduction. It would probably be necessary to use at least four turbines with a mechanical gear instead of two, as with the electric method; this fact alone would make the electric reduction the more efficient of the two. Then there are also the very considerable losses due to the friction and windage of the backing turbine. According to Sir Charles Parsons this loss amounts to about one-half a percent. Also there would be a saving due to the fact that only one set of auxiliaries would be used at a time.

Space Occupied

As regards the actual space that the machinery would occupy, the electric drive would take up less space than any other installation, with the possible exception of the mechanical gear. The arrangement of the machinery, however, is so much more flexible with the electric drive than with other methods that it is probable it would oc-

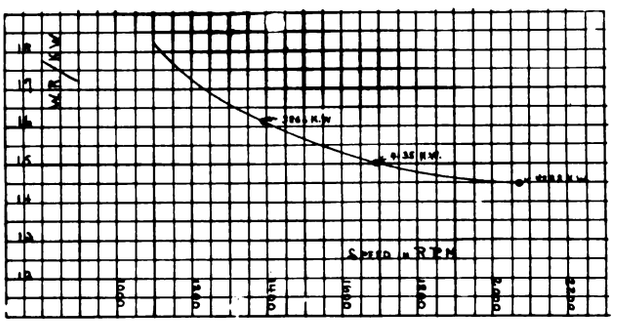

Fig. 2.—4,000 K. W. Turbine *U. S. S. Jupiter*

cupy less space than would the gears. It lends itself very readily to watertight subdivision.

Weight

The next point to be considered is that of weight, and here again the electric drive is superior to any other method with the possible exception of mechanical gears. It is rather difficult to say exactly how the two methods would compare either as regards space or weight, as a great deal would depend on the number of turbines used with the mechanical gear in order to get 30,000 shaft horsepower. However, if the largest sizes of geared turbines now at sea are any guide, the weight of the electric drive would be less than the weight of the geared turbine.

Care and Upkeep

As regards care and upkeep, the electric drive is greatly superior to either reciprocating engines or direct-connected turbines, also due to the fact that the turbines do not have to reverse, it would be superior to the geared drive in that it would have less blading trouble. Either of the two latter methods, however, is very satisfactory

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in this respect, as a high-speed turbine is so small that it is easily handled and repaired by the ship's mechanics.

This completes the case of the electric drive for battleships; all of the points have been considered and in every case it has been seen that it has no superior. There are, however, some points that have been made against electric propulsion, and these will be taken up before proceeding to a discussion of the *Jupiter's* installation. First, there is the danger from large quantities of water in the engine-room; however, this danger is more fancied than real, as all the wiring could be placed well overhead, being taken out of the tops of the motors and generators. The generators could be placed high enough to insure their safety and the motors could be placed in watertight pits so that the engine-room could have enough water in it to put the auxiliaries out of commission before reaching the main engines. The next point is that, when operating with one turbine, all motors must run at the same speed if they run at all; this fact has been found to be no handicap in actual operation. The next point is that, in turning, the inboard screw does not slow down; this slightly increases the turning circle, but does not increase the space necessary to turn in, as the inboard screw can always be stopped or backed.

The equipment on the *Jupiter* is similar to that which would be used on a battleship, so it offers a good example of many points that have been advanced in favor of the electric drive.

U. S. S. JUPITER

The *Jupiter* has been in commission over a year and a half. During that time she has conducted two official trials and has carried on the usual routine work of a navy collier. She has steamed about 14,000 miles and has been handled a great deal around docks, in narrow channels, and other places where a great deal of engine handling was required. About one-half of the steaming has been done in the tropics with circulating water over 80 degrees F. and with correspondingly poor vacuum, so that the economy of the ship is known under all conditions. The fuel economy has proved to be excellent, being, on the average, about 25 percent better than the best of her sister colliers.

During the whole period of commission, two repairs have been made to the main engine. The first was to reblade the first stage of the turbine. This work was done entirely by the ship's mechanics. The first stage blading was injured by a bolthead from the segment carrying the fixed blading. The bolt was broken off, probably through having been set up too hard while assembling. These bolts were all tap bolts and have been replaced by filister head screws with countersunk heads and a repetition of the accident would not be possible. The accident, however, was in no way peculiar to the electric drive, as it might very well have happened to any other engine. The other repair was to replace one of the porcelain cylinders which carry the resistance; this cylinder was cracked when the ship went into dry-dock, but it was never discovered whether the cracking was due to the oiler putting undue pressure on the cylinder or due to some strain brought on it when the ship settled on the keel blocks. At any rate the damage was repaired by two machinists in about two hours.

The amount of work expended in keeping the equipment in condition has been very small. After coming in from a run, the turbine clearances are taken to see if they have changed; and the motor clearances are also checked; there has been no change in either of these clearances up to date. Before getting under way the holding-down bolts of the turbine are gone over to see if they are tight, the slip rings on the motor of the generator are examined to see if they are clean, and all insulators are also examined for cleanliness, all connections are generally gone over to make sure they are tight, the oil switch boxes are examined to see if they have the proper amount of oil, and the governor control-valve springs are tested to see if they have the proper tension. After starting the turbine, the emergency trip is tested. In port the oil pump is run once a week to force oil through the turbine bearings and the motor shafts are jacked daily. Due to the fact that the main condenser is used a great deal (the auxiliary condenser being too small to handle the coaling winches), the small pump for draining the turbine casing is run for a few minutes each day when in port to make sure that no water may be allowed to accumulate in the turbine.

In operation the *Jupiter's* engines have been highly satisfactory. There has been only one time when anything has happened during the handling of the engines and that was the tripping out of an exciter. The lighting set was immediately put on for exciting and the engines were ready to use again in about one and one-half minutes. If such an accident were to happen again it would take even less time, as the men are more familiar with the installation. At the time the accident occurred the ship had just left the navy yard for the first time.

The handling of the engines has been proved more than once; the ship has been handled a great deal in narrow waters and around docks. She steers very badly at times and the quick response of the engines has more than once helped in getting out of difficulties. The engines have been used to swing ship for compass deviation without putting any way on the ship at all, the total space used for swinging being little more than the ship's length.

The ability of the turbine to stand severe abuse from water has been demonstrated several times. There is no separator on the main steam line, and several times the boilers have primed and carried considerable water over into the turbine. This was particularly noticeable during dock trials, when it was impossible to properly handle the boilers. The only indication the turbine gave was an increase in the first stage pressure and a rattle in the casing as the water was hurled through at a high rate of speed, but the turbine blading showed no signs of bad effects from this.

The backing qualities of the engines have proved to be all that could be desired; if the ship is cruising with the resistances in, the time taken for reversing is practically nothing at all; if the resistances are out, it takes a few seconds—not more than three.

When underway the engine-room is very cool, due to the fact that the generator is fitted with air impellers at each end which take their suction from the engine-room, thus insuring a good circulation of air.

After all, the greatest test of the satisfactory working of any machinery is whether the men who are actually handling it and caring for it are pleased with it. If this test applies to the *Jupiter's* machinery it certainly is an unqualified success. In particular is this true if the matter is referred to the coal passers in the fire-room who have to handle much less coal than do the men on sister ships. The ship can make her contract speed of 14 knots without using forced draft at all.

Submarine Signalling and Proposed Method of Safe Navigation in Fog

BY COMMANDER F. L. SAWYER, U. S. N.

ABSTRACT

The purpose in this paper is to present a proposed method of avoiding collision when navigating in fogs. The sole means of avoiding collision in a fog at the pres-

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ent time is that prescribed by the "Rules of the Road"; namely, the fog whistle or siren. So far as range, efficiency and reliability are concerned, these fog signals have made no appreciable advance since our largest men-of-war used steam as auxiliary to sail power. The present methods of navigating vessels in a fog are totally inadequate to insure reasonable security to life and property and the danger of collision in fog always exists.

A satisfactory system of fog navigation would require:

(a) The presence of another vessel to be ascertained at least as far as the steamer lights are visible—namely, five miles.

(b) A knowledge of the course and speed of the other vessel.

(c) Information as to whether or not the bearing of the other vessel is changing without changing the speed and course of either vessel.

(d) Ample sea room to change course in case such maneuver is found necessary.

(e) Simple means and apparatus involving no calculations or estimates to be made so that an intelligent navigator can carry out the method.

In order to accomplish the above, the method proposed contemplates the use of the simplest form of wireless with any efficient form of submarine wireless. In case of fog simultaneous signals are sent from a vessel and only a single letter or number in the Morse code is necessary to be sent. The twenty-six letters and ten numbers each represent ten degrees of the compass, so that any course is signaled to the nearest five degrees, with an average error of less than one-quarter of a point. The observer using an ordinary double head-piece receiver on another vessel receives the wireless signal and submarine wireless signal, but not simultaneously, as the former is instantaneous, while the latter, at five miles distant, for example, arrives more than six seconds later. This very considerable interval renders it easy to measure the distance between vessels with greater accuracy than necessary for purposes of navigation. After arriving within range of the submarine wireless signal, the vessels are able to know at all times their distance within an error that should not exceed 300 yards.

In the practical application of this method at sea, a standard wireless installation might be used, but such range and power are not required. A short wave length of not more than 200 meters, such as is reserved for the use of amateur operators, would be sufficient for the purpose. An inexpensive set with a variable frequency would be practical, by which the changing pitch and single letter would indicate an unmistakable fog signal. There would be no danger of interference with submarine signals. If more than one vessel were within the field of audibility, the variations in speed or course would eliminate any probability of confusion.

The recent simultaneous tests of the Berger and Fessenden submarine systems have shown an effective range of ten miles for both. A range of five miles should show four times this intensity, and, therefore, this element in the system appears to be solved.

The method above outlined appears, therefore, to furnish the information necessary for safe fog navigation, namely, at a range of over five miles, speed and course of other vessel, whether her bearing is changing, sea room to maneuver if necessary, the condition that both vessels are liable to hold their course and speed until bearing change is ascertained, and, in addition, the distance separating the vessels. Vessels having this knowledge will in nine times out of ten find themselves passing more than one mile apart without either changing their course or speed.

Naval Engineering Ship Models

BY FRANK VAN VLECK, PH. D.

Admirers of things nautical and naval, when visiting Washington, often seek out and study the beautiful ship models to be found in the corridors of the Navy Department and in the marine section of the Smithsonian Institute. There is no collection equal to these two anywhere in America, and but few in Europe. In addition, there are a few excellent ship models in the hallways of the Treasury Department, illustrating the fine vessels of the Revenue Cutter Service. In the Post Office Department a few large and unusually well-developed models are shown of a few of the representative ships of the mercantile marine, as used for the transport of United States mail. These ships, however, fly foreign flags. The United States War Department has also had executed some good models of military transports, showing the complete ships and longitudinal inboard sections.

Should all of these models be gathered together they would make a marine exhibit which would attract profound attention even from those who are not specialists in naval architecture. Many of these models are being prepared for shipment to San Francisco for exhibition at the Panama-Pacific Exhibition, and will attract deserved approbation from the public at large.

But why along with these beautiful hull models should we not also have carefully executed models of the propelling machinery of our naval vessels? Because an officer cannot serve with sword and epaulets in the superheated atmosphere of a boiler or engine room does not signify that the machinery in that space is unworthy to be exhibited to a people who demand to know what makes the vessels plow the seas so majestically. The precedent for such models, which the Navy Department should not ignore, is the fact that the Revenue Cutter Service already has on exhibition in the corridors of the Treasury Department at Washington three or four excellent models of marine engines built on a scale of one inch to the foot. Captain C. A. McAllister, engineer-in-chief of the Revenue Cutter Service, has taken great pride in working out the details of these splendid models, and has stated that he now has more of them in preparation.

As an educational feature, working models of marine machinery are essential, especially when the opportunity to inspect the actual machinery itself on board ship by the people throughout the country whose money has paid for this construction is very remote. Will not their knowledge, appreciation and enthusiasm be greatly enhanced by the existence of such models in public places, even if only a few of them are professional mechanics and understand the details of such machinery?

Some slight familiarity with the complicated details of the machinery of monster battleships will bring to the uninitiated layman some realization of the existing importance of the ultimate training of the naval engineer officers who are called upon to control this machinery. Steam engineering, not seamanship, must win the battles of the future. A captain in action, fighting for the weather gage to get in his broadside, can no longer thrill his crew with his hoarse commands of "Rightabout," which will bring his ship to its best fighting position, but rather will it not be the captain who is an engineer who will win the battle—a man who in distress gets 19 knots out of an 18-knot engine? To convince the world that the man on the quarter-deck must be an engineer, is it not wise to show the people the intricate machinery below decks?

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Werkspoor Motor Ships in Service

Working Results of Nine Diesel-Engined Sea-Going Vessels—Mishaps that Have Occurred and Their Causes

BY T. ORCHARD LISLE, A. M. I. MAR. E.

At the present time there are just under one hundred commercial ships of over 300 horsepower fitted with Diesel oil engines as propulsive power, the majority of which are equipped with motors of the four-stroke type, and which undoubtedly are giving reliable and regular service. Yet, because about a dozen motor craft that have been brought into the limelight have proven far from satisfactory, there has been a tendency among some shipowners to treat lightly the use of the Diesel engine for ocean-going ships, instead of giving the deep thought and discriminate consideration that it deserves and demands, and inquiring properly into the ulterior reasons thereof. It was this self-same tendency to light treatment by some marine engineers and shipbuilders that has been the main cause of the non-success of a few modern motor ships. There also has been a distinct tendency to overrate many of the machinery accidents.

If more discriminate probing was done by shipowners, and less attention paid to rumors and hearsay, the marine Diesel engine as a commercial proposition would stand far higher in the general estimation than it does to-day. It is important to notice, however, that there are certain shipowners who have practically abandoned coal and oil-fired boilers because of the splendid and economical service that they have obtained with Diesel engines. These owners have the warmest regard for this particular type of power after many years' sea-going experience, which it fully deserves. To quote a few names—The Anglo-Saxon Petroleum Company, The East Asiatic Company, The Nobel Brothers Naphtha Productions Company and the Mercury & Caucasus Transportation Company are such firms.

Curious and interesting reflection is offered by the fact that of the 100 motor ships in service just about one-half were completed before and during 1910, up to when the highest powered two-stroke engined vessel was 360 horsepower compared with 1,200 horsepower for the rival type of motor. These vessels all seem to have given excellent service, and it is only during the last three years that serious troubles seem to have occurred. It is during the latter period that the high powered two-stroke driven ships have joined the steadily increasing list of active motor vessels. Judging by working results I firmly believe that the two-stroke marine engine will most likely meet with its best success in small powers, say 100 to 350 horsepower (if it can compete with the hot-bulb engine), and not in high powers, which is contrary to the general opinion that, by the way, was rashly formed before proper data were available, and partly due to misleading and harmful matter unwittingly published by some of the semi-technical and non-technical journals and magazines.

Serious Troubles Confined to Two-Cycle Engines

Investigation will show that where serious trouble has occurred under sea-going conditions it has been almost absolutely exclusive to the two-stroke type of engine, and due chiefly to heat and bearing issues, which are the outcome of high powers and their relation to the principle of this particular cycle, and have no reflection on the four-stroke Diesel engine. Yet it unfortunately has been made so. But it is not my intention to discuss at length here the pros and cons of the two types, so I will content myself with facts and, by stating that while the two-stroke Diesel engine is still in the experimental stage, the single-acting, four-stroke Diesel is a proven commercial success. Also it is most significant that while many shipowners have given frequent repeat orders for four-stroke Diesel engine-driven ships, there is not a single instance on record of the owner of a two-stroke Diesel-engined commercial vessel having given a repeat order after he has had his first ship in service several months. This needs most careful reflection.

I may add that after many years spent closely watching the development of both types in Europe I have personally reluctantly come to the conclusion that in this decade the marine two-cycle Diesel engine will not become superior to the four-stroke model for commercial ships, although it very probably will be extensively used for naval work, where the question of space, economy and weight are the most important considerations irrespective of protracted duties and running economies. The various admiralties can afford to continue spending fortunes experimenting, but the shipowner and marine engineer cannot, because of the dividends that they must earn, so the lead of admiralties should not be blindly followed. However, the huge economies resulting from the adoption of a proven propelling power make it highly desirable and even imperative for every shipowner definitely to make sure that the four-stroke Diesel engine will, or will not, be advantageous for his individual vessels. There need be no hesitation over the reliability question, for this propulsive power has to-day reached a stage where such firms as the Werkspoor Company, of Amsterdam, and Burmeister & Wain, of Copenhagen, are erecting and installing, under special circumstances, Diesel engines of over 1,000 horsepower per shaft straight into the ships without any previous shop trials. Furthermore, vessels are going on long ocean voyages with as little as three hours' sea trials, and as yet the builders and owners have had no cause to regret the implicit confidence thus placed by them in oil engines. No praise could speak so favorably as this.

At present we can take it as definite that the four-cycle engine is in the van. True, the two-cycle may be improved considerably in time, but the four-stroke also will go on improving, and it already has a great lead that will be difficult to overcome. It is up to the shipowner to decide whether he will adopt a proved commercial success, or machinery with which success is by no means assured, just for the sake of a little extra power. This extra power does not seem to be much, although in theory the difference is great, because there is very little chance in the near future of a two-cycle engined ship of high power being able to run for 20 and 30-day voyages with the throttle full open, and certainly not at the present stage of developments, if I may take existing results as a criterion.

A Marine Superintendent's Views

It is the view of Mr. C. Zulver, the marine superintendent of the Anglo-Saxon Petroleum Company, which owns many motor ships, that, "although aware of the general tendency in favor of the two-stroke cycle (principally because of the attractiveness of the increased power of

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similar cylinder dimensions), one has to consider reliability for continuous work under varying conditions at sea, and in this respect the four-cycle has proved superior. We have the outcome of twelve years' experiment and research, and to sacrifice to some measure this valuable experience in order to build two-cycle engines does not, from a commercial standpoint, appear by any means to be a wise course at present."

I am enabled to give the working results of nine ships that have been installed with Werkspoor four-stroke type Diesel engines, with details of the various slight mishaps that have occurred on different voyages. The revealment of this information will, I hope, do much to allay the fears that large heavy oil engines cannot be relied upon under severe or general conditions of ocean-going work. Business competition naturally was a factor in preventing these data from being publicly discussed previously, and the stage now reached eliminates all necessity for semi-secrecy. These reports are based on information furnished by the owners.

First of all I will deal with the *Vulcanus*, for she was the first real ocean-going vessel, outside of Russia, afloat. She was placed in service by the Anglo-Saxon Petroleum Company of London in 1910, and after over five years' steady work is still giving excellent service. She is a full-lined vessel of 1,900 tons displacement, with an oil-carrying capacity of 1,000 tons, and her direct-reversible Werkspoor 450 horsepower engine gives her a speed of 8½ knots.

The marine superintendent of her owners estimates that her total saving to them over steam has been about $11,000 (£2,250) per year, although she is but a small boat. During her first two years' service she covered about 45,600 miles, and her engines made over 12,000,000 revolutions, yet the wear on the cylinder liners was exceedingly slight. The fuel consumption was not over two tons per diem.

Being a pioneer craft and designed six years ago, the engines of *Vulcanus* were frequently overhauled for examination by desire, and not necessity; but after long voyages everything was usually O K, sometimes a few piston rings were renewed, and sometimes the precautions were taken to re-grind or renew the exhaust valves, although the latter have given no trouble. While exhaust valves are usually considered to be a weak point of four-cycle Diesel engines, no inconvenience or delay has ever been caused in this respect. Occasionally trouble was given by the air compressors.

Mishaps to the Vulcanus

Only on one occasion had the *Vulcanus* to be assisted. On her third voyage to Hamburg the brick lining of the exhaust pipe collapsed, partially choking the exhaust passage and so reducing the revolutions of the motor. The engineer not knowing the cause, and still under the influence of his steam engine training, further opened the throttle, thereby considerably overloading and choking the motor, etc. She was towed from the Elbe lightship to Hamburg and was held up for four days under repair.

On another voyage there was a bending of the crankshaft, due to a bottom end bolt breaking and fouling the crank. The latter was due to a careless overstraining of the connecting rod bolts during an overhaul by a firm which was not the builder of the engine. However, the bent shaft and disturbed timing did not prevent the *Vulcanus* from running another three months, when a new crank shaft was put in.

Another accident was the exploding of an inblast air reservoir, while the engines were being overhauled at the builder's yard at Amsterdam. Bad welding had left a fracture, and the top part of the air vessel blew right off, causing the second engineer to lose his left arm—a most distressing and unfortunate occurrence, but which was not directly due to the engine or its builders. The indirect cause was the accumulation of water in the air retainer, which had not drained owing to a cracked internal pipe. This mishap taught the builders of the machinery to dispense with welded air bottles and suspend them with covers and valves downward, thus effectually preventing any unknown accumulation of water.

In summing up these little accidents it should be borne in mind that the makers of the engines of the *Vulcanus* at the time had no experience of high sea service upon which to base their designs. With later ships advantage was naturally taken of this first experience, and consequently very little trouble has ensued. As a matter of fact the Werkspoor Company guarantees reliability with present-day engines. On her first trials, by the way, the only man in the engine room for some hours was a representative of a London engineering paper, the engine room crew suffering from an attack of sea-sickness. Yet there was no governor on that particular engine, and everything worked sweetly.

Record of the Juno

The *Juno*, a tanker of 2,450 tons deadweight capacity, 4,200 tons displacement, and fitted with a six-cylinder 1,100 horsepower Werkspoor Diesel engine, left Rotterdam on her maiden voyage to Braila (Black Sea) on November 22, 1912, arriving on December 15, having used for all purposes 86.21 tons of oil fuel, or 3.75 tons per day, and made an average speed of 9 knots. She spent seven days in port under overhaul. A few piston rings were found stuck, otherwise everything was in good condition. Her auxiliaries are driven by steam, generated in a donkey boiler, partly fired by the exhaust gases from the engine and partly by an oil burner. This has been done with success in all later Werkspoor vessels, except that the heat from the exhaust has now been found sufficient for the purpose. The fuel consumption of the *Juno's* engines has since been reduced, and it works out at 0.3 pound per indicated horsepower hour, which is about 17 percent lower than with two-stroke engines of similar power.

It has been found possible, by reason of the great accessibility afforded by the design, to examine and clean all the pistons of the *Juno's* engines without disturbing any cylinder heads, pipes, valves, cams, etc. The *Juno* has since been in regular service, and Mr. C. Zulver, marine superintendent for the owners, the Anglo-Saxon Petroleum Company, stated that "the plain, unvarnished truth is that her engines gave very little trouble indeed, wear and tear of moving parts being very slight, and less than is usually found in marine engines." A little difficulty was at first experienced with cooling pumps, through the capacity having been based on land practice and proving insufficient. All these minor mishaps, already referred to and as follows, have been a splendid education for the builders of the engine, and the lessons learned are used to advantage in present-day ships, and they are indebted to the co-operation of the various owners in assisting them to make good.

A year previous to the *Vulcanus*, the Werkspoor Company installed Diesel engines of about 200 horsepower in the small ships *San Antonio* and *Sembilan*. Even at this early period these vessels gave good results (and still run excellently). In 1911 one of the voyages of the *San Antonio* was from England to Brazil and Venezuela and back.

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I will next refer to the *Loudon,* owned by the Royal Packet Navigation Company of Amsterdam, a cargo and passenger ship of 1,750 tons deadweight capacity, and propelled by a 1,100 horsepower Werkspoor Diesel engine of the four-stroke type, and which commenced her maiden voyage on November 22, 1913, from Amsterdam to Batavia, arriving on December 31, having averaged over 10 miles an hour. The chief engineer reported that, when between Amsterdam and Flushing, the flow of lubricating oil diminished, which was soon found to be due to clogging of a pipe in the filter and was quickly remedied.

Another minor mishap was experienced on account of some very heavy oil fuel having been pumped in error to the solar oil filter. Naturally this fuel was too thick to follow the speed of the fuel pump, and the engine slowed down. Shortly after the machinery was stopped in order to drop the pilot, and the engine would not restart on the heavy oil, as the adjustments were not suitable. But after draining the pipes and filling them with solar oil, the trouble was over. It is rumors based on such little accidents as these, and which increase in seriousness as they pass from person to person, that do so much harm to the Diesel engine industry. As a matter of fact, the engines really worked excellently, no hot boxes occurring, not even on the first few days when the ship was rolling heavily.

After arriving in the East Indies the *Loudon* regularly plied between different ports in the Dutch colonies. On one voyage, from Batavia to Palembang, she spent 4 days and 5.3 hours loading and unloading in the different ports en route, while the actual running time was 2 days 18.9 hours. There were no standby losses, other than wages and food, but a steamship would have had exceedingly high stand-by losses, because of the necessity for keeping up a head of steam.

LATER VESSELS

Very fine performances have been given by the *Artemis,* a ship of 7,720 tons displacement, and 5,050 tons deadweight capacity, fitted with two 1,125 indicated horsepower Werkspoor four-stroke Diesel engines and owned by the Anglo-Saxon Petroleum Company. On April 7, 1914, she left Rotterdam on her first voyage, bound for Constanza, returning in May. In June she left Rotterdam for Shanghai, reaching Alexandria en route twelve days after (average speed 11 miles per hour), and her destination was reached towards the end of July.

A few troubles were experienced underway, consisting of several hot crank pins and crosshead brasses, which were scraped up and adjusted in port. These mishaps were due to the use of lubricating oil that proved too thin. Since then a more substantial oil has been used and the troubles of *Artemis* were over. Her total fuel consumption averages not over 7 tons per day, which the marine superintendent of the owners wrote saying was a marvelous performance for a ship of her size and power. He went aboard at Port Samboe on July 18, and the following is an extract from his report:

"On the arrival of the *Artemis* at Port Samboe on July 18, we went on board and are pleased to say that our high expectations of the Diesel installation of this ship had not been disappointed. We noticed the various improvements with great interest and satisfaction, and the chief engineer informed us that he had experienced no trouble with the engine except a few crankpins and crosshead brasses, which he scraped up and adjusted here."

It may be remembered that a new piston-cooling arrangement was devised by the Werkspoor firm a short time ago, and in this connection the superintendent states that "it works quite well and gives no trouble." He further adds that "it is gratifying to learn that sufficient steam (for the auxiliaries) can be raised with the exhaust gases, thus creating a substantial saving in the oil fuel bill."

A sistership to this vessel is the *Ares,* which carried out her trial trip on May 19 last, when a speed of 11¼ knots was attained, that is to say, about one knot over the guaranteed speed. On the same day as she ran her trials she sailed for Rotterdam, where she loaded and left on May 28 for the Black Sea. She had to put in at Lisbon Harbor on account of lubricating oil, a mistake having been made in the quality, which was found to be far too thick.

On July 10 the *Ares* returned from the Black Sea to Rotterdam, having made a run of 3,634 miles in 16 days at an average speed of 9½ knots, which, with the exception of stopping the starboard engine to replace the chain which drives the cylinder lubricating pump, was a non-stop run. In the same month she sailed for the East Indies.

The third sister boat, the *Selene,* ran her trial trip on August 29 last, and sailed for Port Arthur, Texas, on September 5, which port she reached on September 27. Owing to the mines which were laid in the North Sea, the trials of this boat were of exceptionally short duration (three hours moored and four hours at sea), and after this very short trial the ship left for a 22-days' voyage. The engineer's report mentioned great satisfaction with regard to the heating of the boiler by the waste gases and the consequent lower fuel consumption.

On days when there was fine weather a speed of nearly 11 knots (ship unloaded) on a fuel consumption of only 6¼ tons (2,250 indicated horsepower) was attained, which was even better than the performance of the *Artemis.* This includes everything needed for the auxiliaries, such as the steering gear. The Werkspoor installations, by the way, appear to be the only ones at present existing in which the exhaust gases are employed for raising steam for the steering engine and pumps with such satisfactory results. The *Artemis* stayed at Port Arthur for four days loading and making adjustments to the engines, this being necessary owing to the short trials referred to.

Finally, but not least, is the *Elbruz,* a sistership to the twin-screw vessel *Emmanuel Nobel,* which was placed in service a year ago. Both vessels are of 6,230 tons deadweight capacity, and are equipped with two 1,100 horsepower Werkspoor four-cycle Diesel motors.

The *Elbruz* was commissioned in July last and, it is interesting to note, her engines were installed in the hull without even turning round in the shops under power. After a few hours' tests when moored she ran her trial trip, and the following day she started for Constantinople, reaching there 13½ days later after a successful voyage without particular incident.

Having fully explained the slight mishaps that have occurred to various Werkspoor-engined motor ships it is to be sincerely hoped that shipowners will fully realize that they can without the slightest trepidation or hesitation place an order for a commercial ship with carefully selected four-stroke Diesel motors as the propulsive power, and be sure of obtaining the same reliable service as they are accustomed to having from steam.

Before concluding there is one important query that should be made clear, namely, the desirability (?) of specially trained men in the engine room. In connection with this I would point out that it has been stated by the marine superintendent of the Anglo-Saxon Petroleum Company that "their experience is that any marine engineer of ordinary intelligence and experience can soon become capable of running and handling a Diesel engine installation, and

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it is certain that no special or highly skilled men are necessary." This assurance, coming from a marine engineer of extensive sea-going experience, and who is in charge of a large fleet of steam and motor vessels, will no doubt give a strong impulse to the more general adoption of Diesel engines for ship propulsion and satisfy shipowners on that score.

Tank Ship Construction*

BY ROBERT WHITING, MORRELL, M. E.

Each bulkhead usually has two or three vertical web stiffeners, which should be on the same side as the bulb stiffeners, as it is very bad practice to put any stiffeners on the calking side of a bulkhead. These webs are slotted out to fit around the bulb stiffeners, and are clipped to the bulkhead by short clips between the horizontal bulb angles. The webs, consisting of plates, face bars, and short horizontal clips, are assembled and riveted separately on the ground; but the clips connecting them to the bulkhead should be rivted to the bulkhead. The webs can be riveted complete, except for the short horizontal clips which catch the bulb stiffeners, and also the face bar should be left loose for a short distance, top and bottom.

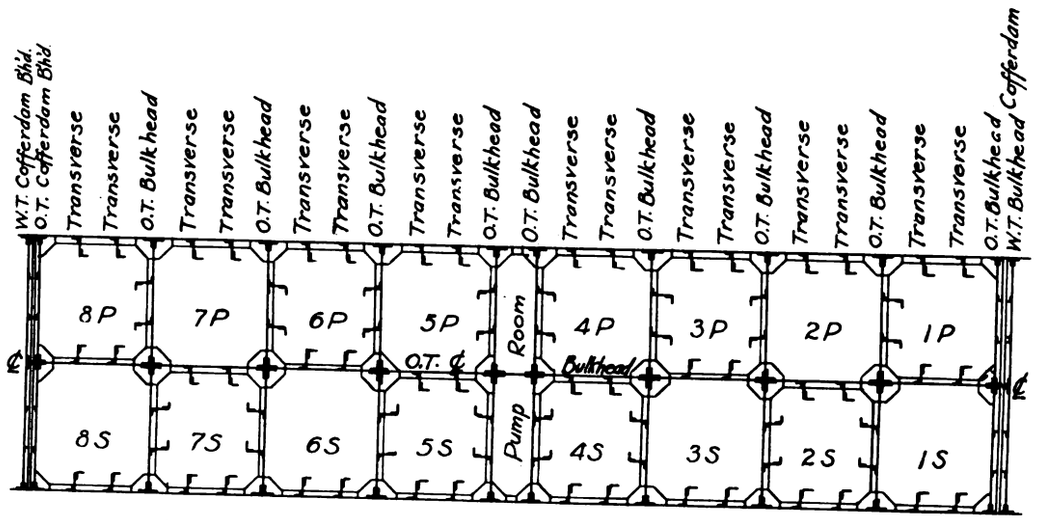
It is advisable to cut a small door or manhole in each bulkhead for convenience in access to the various tanks without having to climb over the bulkhead to get from one tank to another during the course of construction. Later a cover plate can be riveted on this opening.

It is a great advantage to do all possible riveting and calking on the ground, but the work should first be checked by battens for half widths and heights. The bulkheads can be riveted on the ground complete, with the exceptions noted above, and are then ready for shipping. The bulkheads on the side of the ship away from the overhead crane, if of the cantilever type, are apt to be too heavy to lift in one piece, and should therefore be broken in half at a seam in the plating.

A ribband should be run at the main deck to catch the bulkheads, and diagonal braces should also be used. One or two vertical ribbands should be bolted to each bulkhead.

Just as the calking side of the centerline bulkhead reverses in adjacent tanks, so the calking side of the transverse bulkheads reverses on opposite sides of the ship, with a few exceptions. For example, starting at the forward end the forward bulkhead of the cofferdam has its calking side forward, both port and starboard, while the after bulkhead of the cofferdam has its calking side aft, port and starboard. This is necessary, as these bulkheads have vertical webs in common, which must be on the non-calking side. But the next bulkhead aft has its calking side forward on the starboard side and aft on the port side, while the second one has just the reverse. If the pump room is amidships, the calking sides of both pump room bulkheads should face into the pump room, in order to keep the stiffeners out of that space.

This feature causes complications in shipping the bulkheads, for it will be found that it is not feasible to put them all in the ship at this stage of the construction; in fact, only half of them can be shipped. The reason is a roundabout one, and difficult to follow, but stated as simply as possible it is that any given bulkhead cannot be put in on both port and starboard sides without first having the centerline bulkhead plating between the two parts; and this plating can not be hung in place until the transverse or belt frames are in the ship (on one side only in each tank), to attach the centerline plating to. Therefore, the situation is that we can put half the bulkheads in the ship, and simultaneously we must have half the transverses ready to put in.



Diagram, Showing Arrangement of Bulkheads and Transverses in Oil Space

The transverses can be assembled on the skids to advantage. It will be seen that they are not symmetrical, for on the non-calking side of the centerline there is a web, with slots to take the centerline stiffeners. These frames are the ones wanted first. The entire frame is notched or slotted to take shell longitudinals, deck longitudinals and centerline stiffeners. Lloyds require that the corners of these slots must be punched round to prevent tearing. They also stipulate that the butt laps of the plating must come between slots, and that the lightening holes must be nearer the face bar than the outer edge.

The frame is connected to the shell, deck and centerline by clips between the slots. If possible, these clips should be made single, as double clips cause much trouble on the skids. The best practice, instead of working these connections as short clips, is to work them as continuous bars and cut them out at the slots after riveting. This, of course, causes considerable waste of material, but has many advantages to offset this fault.

Clips are likely to get lost when most wanted, and they would require fairing clips to keep them in line for rivet-

* Continued from the December Number.

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ing, and even then would be apt to be unfair. At the turn of the bilge it is much cheaper to joggle, bevel and bend a continuous bar than a collection of clips. By sawing through the shell flange at each slot the chipping on the skids is reduced to a minimum. No holes should be put in these bars where they cross shell seams. They should be joggled in way of outside strakes.

The transverses can be riveted complete on the skids, with the following exceptions: the shell clips next the centerline and the deck should be left loose, and if the bilge strake of shell is a skin strake the shell clips at the turn of the bilge should be left loose, the top and bottom clips to the centerline should be left loose, and the outboard deck clip. No riveting should be done until the frame has been carefully checked by half width and height battens. It is even then advisable, but not necessary, to leave one butt lap loose. In working the big brackets at the turn of the bilge, they should be sheared before the slots are punched, for if the slots are cut out first the plate will curl up between slots when sheared.

Having the solid transverses ready on the non-calking side of the centerline they can be put in the ship. The next step is to place the centerline stiffeners in the slots in these frames. At the bottom the vertical keel closes the slots and makes it necessary to reeve the stiffener through. Here it becomes apparent why a careful selection of the bulkheads to be put in the ship is necessary; for unless these bottom stiffeners are placed in their slots before the bulkheads are shipped, it is evident that if the bulkheads are in place at both ends of the stiffener it will be impossible to reeve it through. A similar condition exists at the bilge if the bilge shell is a skin strake. In this case it is cheaper to place this strake on the spauls before the transverses are shipped than to pull it up into place afterwards; but the shell longitudinals can not be placed on this strake, or the transverses could not be entered, hence it is necessary to reeve the bilge shell longitudinals through the slots.

FITTING THE CENTERLINE PLATING

With the centerline stiffeners in place, the centerline plating can be hung. This plating should be designed to have a narrow vertical plate at each bulkhead, in order to do away with linering the bounding angles. (This idea is also applicable to the transverse bulkheads, but its value in that connection is questionable.) Between the vertical plates the centerline bulkhead is worked in horizontal strakes, with joggled seams, the joggle dying out at the end of the plate.

The lap of the plating on the vertical keel may be joggled, except in way of bulkheads, where it dies out and tapered liners are used, as it is almost impossible to make a tight fit of the bounding bar around the joggle. The joggling should always be toward the calking side, except at the lap of the vertical keel, where it must remain always on the same side of the ship. The vertical plates are joggled to receive the ends of the horizontal strakes. The joggling is very complicated and should be watched closely, as in some cases a plate will joggle in opposite directions in a space of two feet. On account of this difficult joggling the stiffener next above the lap of the vertical keel should be kept as far above the lap as is feasible. All the stiffeners should heel down.

The question of assembling the sections of horizontal plating between the vertical plates on the ground has been considered, but owing to the reverse joggling and the stiffeners extending beyond the ends of the horizontal strakes the difficulty in shipping these sections when assembled is so great as to make it unadvisable.

After the centerline plating is completed the remaining bulkheads and transverses can be shipped. These transverses are the ones on the calking side of the centerline, and have no centerline web. A heavy vertical wooden strut should therefore be bolted to the frame near the center line, to hold it to the proper height. These transverses are connected to the centerline by big brackets, usually having double clips. As these clips cross the lap of the vertical keel, where the joggle occurs, it is best to cut away the centerline flange of the clip clear of the joggle to permit better calking. There is a tendency to extend these clips about six inches beyond the tip of the bracket, taking two more holes through the centerline than through the bracket. With double clips this leaves a space between the heels which can not be calked, and is therefore bad practice. It can be made tight by "gunning," which, although very efficient, is costly and is condemned by many inspectors and should therefore be obviated in the design as far as possible.

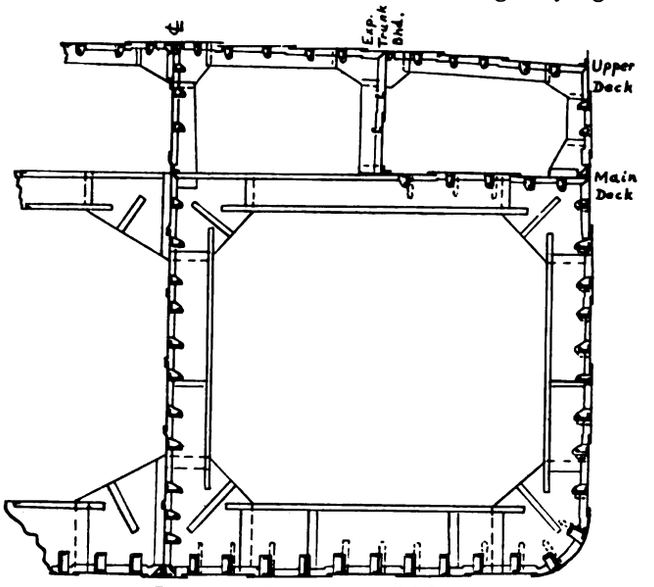

Diagram of Transverse in Oil Space

BILGE AND SIDE SHELL LONGITUDINALS

The next step is to ship the bilge and side shell longitudinals. This is a difficult job for the riggers, especially where the bars are not straight. It is necessary to pull back or cut off the staging spauls, lower the bar down by means of the crane, then with tackles pull it into its slot. It is highly important, from the rigger's standpoint, that the bars heel down. After the longitudinals are complete the shell can be hung.

No bolting whatever should be done, either on the centerline bulkhead or the shell, until the ship carpenters have shored one or more bulkheads accurately into place. If this is not observed, the work on the entire ship will "go bad." With a bulkhead set or "horned," this can be used as a starting point and the centerline bulkhead bolted to it first, then to the other transverse bulkheads, then its own seams and butts, then to the siffeners.

A similar procedure is carried out with the shell. The bracket connections are bolted last of all. In adjusting the shell, it is often necessary to throw away a few clips on the transverses. The bottom or side shell should not be bolted to the transverses until the transverses are bolted through the centerline. This is to prevent the transverse from sagging and pulling the centerline out of plumb.

The vertical webs on the transverse bulkheads can be shipped at any time, and there is great advantage in putting these webs in the cofferdams before the bulkheads are

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bolted in the ship, as the webs will go in much easier if the bulkheads can be sprung apart.

MAIN DECK

We now come to the main deck. This being an oiltight deck, should have solid wooden molds made for it in the loft. It is preferable that the main deck should have no camber. The deck longitudinals should be dropped into the slots in the transverses, to be followed immediately by the deck plating. As this deck is only the width of the summer tank, it usually consists of three strakes, one of which is the stringer.

The middle strake should be lifted from the ship, and the deck should be bolted at once so this can go ahead, starting at the "horned" bulkhead. The deck stringer angle amidships should be put on, as well as the deck angle to the expansion trunk bulkhead, as these will aid greatly in regulating the deck. The rule is to bolt bulkheads first, then butt laps, then transverses. At the shell and expansion trunk the deck plating should be cut neat to the heel of the bars in way of bulkheads, although it may be cut slack between bulkheads.

A difficult point to make tight is the intersection of the main deck and expansion trunk bulkhead at transverse bulkheads. Various methods have been tried, such as flanging the deck plate up and lapping the expansion trunk plating on it, or extending the main deck plating inboard of the expansion trunk as a web, slotting the transverse bulkheads and stapling around the slot. The former is not very good, as it is hard to fit the bounding angle to the flanged plate. The latter method works fairly well. The inboard edge of the deck plate is flanged up for stiffness, the flange being cut away at the bulkheads, and at butt laps it can be drawn in slightly in the machine to save furnacing.

As soon as the deck is bolted, the ribband can be taken down and the shell hung in way of the deck, which will permit regulating it with the stringer angle to good advantage. The deck longitudinal brackets at the bulkheads should be put up and the longitudinals bolted, in order that the strake of deck plating can be lifted. Staying should be put in the tanks at the earliest possible moment, in order that the bolting can go ahead.

The transverses between main and upper decks inside the expansion trunk are the next members wanted. As soon as these are shipped, the expansion trunk stiffeners can be placed in their slots and the expansion trunk plating shipped. This plating, like the deck, should be cut neat in way of bulkheads.

After bolting this plating the transverses and bulkheads in the summer tanks can be put in the ship. These bulkheads divide the space into much longer compartments than the main tanks, with swash bulkheads between. The swash bulkheads should have an access manhole at a convenient height above the deck. The oiltight division bulkheads in the summer tanks should not have their bounding angles gotten out in the loft except those under the upper deck. The bounding bars to shell, main deck and expansion trunk should be lifted from the ship, and care should be taken that there is a space left open to get these bars in after lifting.

UPPER DECK

We are now ready for the upper deck, which joins the top of the main tanks and the summer tanks. This deck has the usual camber. Most of what has been said regarding the main deck applies here as well. The strakes of deck plating directly over the centerline and expansion trunks should be lifted from the ship. Not more than two adjacent strakes should be gotten out in the loft. Oiltight deck plating should not be joggled; it is best to work the strakes clinker-fashion, with the clips on the transverses joggled, and tapered liners used in way of bulkheads.

The oiltight hatches are generally located on the upper deck, although in the shelter deck type there may be an oiltight trunk leading to the shelter deck, with the hatches on the shelter deck. There is a hatch for each tank, usually consisting of a small trunk, with a hinged cover and suitable dog clamps and asbestos gasket. In the cover is a cast steel or brass handhole and hinged cover, which is left open for air when filling or discharging, and also in order that the height of oil may be observed. The cover has a rest rod to hold it partially open.

In order to insure fairness of holes in the angle connecting the hatch to the deck, the deck flange of the angle should be left blank until the deck plating is assembled on the ship. Then before the hatches are shipped the deck holes can be lifted, applied on the hatch angle, and drilled off. Deck holes in the proximity of the hatch corners should be omitted, in order to prevent the possibility of their coming in the toe of the angle; if any such holes occur they should be driven flush before the hatches are shipped.

Hatches should not be located too close to the calking edge of deck plating. The vertical metal ladders in the main tanks should be put in place before the hatches are shipped.

In the bridge deck type the hatch covers are raised by means of a fall attached to the fore-and-aft bridge. In the shelter deck type, if the hatches are on the upper deck, it is necessary to provide a gas trunk around each group of hatches, and extending from the upper deck to the shelter deck, to prevent oil fumes from getting into the 'tweendeck. These gas trunks are apt to be a source of danger, as the oil vapor, which is heavier than air, will collect in them even when they are wide open at the top, and a man entering the trunk can very readily be overcome.

The trunks are watertight, and as they rest on the oiltight deck their bottom angles must be calked heel and toe, and the trunk plating should be cut slack for this purpose. Although it is somewhat risky, these angles should be gotten out in the mold loft, as they must be in place and riveted before tank-testing can begin. Ordinary practice would indicate lifting the bars after the decks and trunks are adjusted, but the delay would be too great. The trunks can be assembled on the ground and these bars bolted to them, but not riveted.

Over each trunk is an opening in the shelter deck, which is similar to an ordinary cargo hatch, with coamings, strong-backs, wood covers, etc. These hatches should be kept as small as possible, in order to maintain the strength of the shelter deck. In this case the oil hatch covers are raised by a fall attached to the coaming or strong-back above, but there is no provision for lifting the strong-backs themselves, as this is not likely to be necessary.

If the oil hatches are located on the shelter deck, a special oil trunk must be fitted in the 'tweendeck, and a special means of raising the hatch covers must be provided on deck. This system, while it enables a greater amount of oil to be carried, and does away with the gas trunks, is apt to cause an enormous head of oil in the tanks, which may be harmful.

Access to the cofferdams is obtained by means of small trunks with hinged hatch covers at the top, very similar to the oiltight hatches, but much smaller. Access to the pump room is provided through the pump room skylight,

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which is a large bolted skylight located on the weather deck over the pump room hatch, and fitted with a watertight door.

MASTS

Masts on a tank ship are unnecessary, except to carry lights, flags and wireless. If cargo booms are required for the hold forward of the oil space, a derrick post would be sufficient. No coaling gear is necessary, as this is furnished by the lighter or pier. So long as masts are used, however, they rest on the oiltight deck and must be provided for. A doubler is fitted on the deck, with an angle ring on it, to take the foot of the mast. The doubler is riveted to the deck, but the ring should be riveted to the doubler only, before it is put down. This is so that, if the mast works in the ring, it will not loosen any oiltight rivet. The deck rivets must be chipped flush, as well as the rivet heads under the ring, before the doubler is put down. If there is no shelter deck, the mast has no support other than its shrouds and stays. As the mast rests on the centerline bulkhead no additional foundation is necessary.

We have now covered the main structural features of the oilspace. The oiltight work requires minute care as to the fairness of holes, the tightness of bolting, the soundness of riveting, and the thoroughness of calking. Before bolting up a bulkhead, deck, or shell, it should be carefully regulated as a whole. No work should be reamed in the ship until all the adjacent members have been set and adjusted satisfactorily. Not only must the oiltight work attain a high degree of perfection, but all work in the oil space, even if not oiltight, involves important strength members and must be up to a high standard.

PACKING

In regard to packing many specifications require that oiltight work must be metal to metal; but in the best practice a packing of canvas or lamp wicking soaked in red lead is freely used, especially in places not readily calked. For example, packing is generally used in laps of shell plating in way of bulkheads and under most clips located on the calking side of a bulkhead. The principal object to attain, however, is fair holes and work bolted up tight. "Dutchmen" and shim liners are very undesirable on work readily accessible. Packing may be omitted; for instance, on bilge keel bars it is not necessary to pack, provided the bars have the proper "set" to suit the curve of the bilge. The bilge keel bars should have the shell flange cut clear of the shell butts to facilitate calking, and in some cases the bars are also cut clear of the riveting through the transverses. When the shell flange is cut away, however, it should be done by chipping after the bars are in place; for if they are cut in the shop they will break in handling.

Fittings on an oil-tight deck, such as bitts, chocks, rail stanchions, fore-and-aft bridge supports, pipe brackets, etc., should be carefully packed and calked. A chock foundation, in this case, instead of having the usual flanged plate riveted in the bosom of the deck stringer angle, should have a clip riveted to the angle, and the plate riveted to the clip after the necessary calking has been done. Deck winches should not be located on the oiltight deck, if avoidable, and under no circumstances should a wood deck be fitted on an oiltight deck.

TANK TESTING

Tank testing is a large item in the tank ship and should be started at the earliest possible moment, and all efforts should be directed toward that end, as it is highly desirable to do all testing on the stocks rather than overboard or in drydock; and if it is to be completed before launching, it must be out of the way in time to permit painting, fitting the cradle and taking down staging.

Every tank must be complete in every structural detail before water is put in. Usually, the aim is to test the tanks next the pump room first, in order that work in that space may go ahead. In general, the rule is to put water first in the tanks in which the calking sides of the bulkheads occur and test the shell, decks and expansion trunk; then, after dumping these tanks, the tanks in which the stiffeners occur are filled, and a final test is thus obtained of the calking sides of the bulkheads. This brings out the advantage of alternating the calking sides of the bulkheads. The tanks filled should balance each other, so that too much weight is not put on one side of the ship.

The ordinary tank testing on the stocks does not take in pipe fittings and many other fittings which are not installed until near completion. It is wise, therefore, to refill the tanks when the ship is completed in order to examine all pipe connections at bulkheads and decks, and all fittings such as pipe hangers, guards and brackets, operating rods, staunchions, clips, pads, etc., which may have been added since the original test.

(To be concluded.)

A Lumber Crane of Large Capacity to Be Installed on a Steamship Pier

The Seattle, Wash., Port Commission has recently awarded to the Shaw Electric Crane Company of Muskegon, Mich., a contract for a lumber-handling wharf crane, which will be larger than any crane previously installed for this class of service.

This crane is of the double cantilever type, with an overall length of a little over 200 feet, and the range of travel along the pier is approximately 800 feet. The end of the crane bridge projecting over the water is hinged to swing upward for purpose of clearance.

Lumber will be handled by a special grapple and in units containing 1,500 feet board measure. A standard hook may be substituted for the grapple, for handling structural steel and miscellaneous cargo. The openings through the gantry legs are wide enough to permit carrying material 32 feet long without interference. Means will be provided for transporting 9,000 feet of lumber on one of the gantry legs, in addition to the load carried by the grapple.

This installation is interesting, because it is a forward step in the handling of lumber by the unit system, and because it is the first municipal pier to be equipped with cargo cranes, indicating the progressive spirit of the Pacific Coast cities.

Adventures of the Nantucket

Beginning another chapter in her chequered career, the Merchants' and Miners' line steamer *Nantucket* has resumed service on the run between Boston and Baltimore, in command of Captain McDorman, late of the *Gloucester*, of the same company. She has just undergone extensive repairs at the Newport News shipyard, following her collision last January with the Old Dominion liner *Monroe*, which she sank off Hog Island, Va., with a loss of forty-four lives.

Renewal of a number of smashed bow plates, however, has not been wholly responsible for her losing the greater part of a year's work. After the tragedy she was tied up for months by litigation quite in keeping with the vicissitudes she has undergone of late.

Shortly before the *Monroe* affair she broke down off Cape Cod, southward bound, and was towed back to Bos-

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ton by her sistership, the *Howard*. Just previously she had been run ashore in Vineyard Sound, with a heavy cargo of passengers and freight aboard, to avoid collision with a tow of barges. At this time, too, she sustained considerable damage, but it was small in comparison with that received in her preceding escapade.

While lying at her dock in Baltimore several months before, she caught fire, and for a time seemed doomed. Fire boats, however, pumped so much water into her that she capsized and for weeks lay on her beam ends alongside the wharf—a most unusual performance for a vessel of her size. Her salving by a wrecking concern was a notable feat.

So persistent has been the series of misfortunes which has pursued the *Nantucket* that she has been in commission only about half the time during the last three years. But in the opinion of seafaring men she is now amply entitled to a long and uninterupted period of prosperity.

The *Nantucket* is of 1,767 net tonnage and was built by Harlan & Hollingsworth, Wilmington, Del., in 1899.

Steamer Francis Hanify

The steamer *Francis Hanify*, illustrated on this page, is the seventh lumber steamer which the Harlan & Hollingsworth Corporation, of Wilmington, Del., has built for the Pacific Coast trade. She differs from the others principally in the subdivision of her cargo hold. Vessels in this trade usually go northward from San Francisco for a cargo of lumber, and in a light condition, which has proved to be unusually severe on them during the heavy northwesters which they encounter. It has, therefore, been found advisable to subdivide them much like an oil tanker, so that one or more compartments may be filled with water or oil to increase their draft and correct their trim, as the machinery is placed aft.

The principal dimensions of the vessel are as follows:

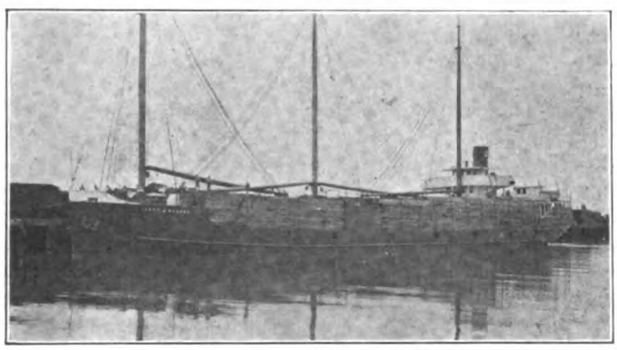

Fig. 1.—Lumber Steamer *John A. Hooper*

Length overall, 309 feet; length between perpendiculars, 294 feet; beam, molded, 45 feet; depth, molded, 21 feet 6 inches.

Hull

The hull is divided into the following compartments by transverse bulkheads: fore peak, Nos. 1, 2, 3 and 4 holds, cofferdam, machinery space, and after peak. As the holds are further subdivided by a longitudinal bulkhead and all riveted work is oiltight spacing, the eight compartments are suitable for carrying a liquid cargo, if required; each compartment is surmounted by a large cargo hatch having high coamings and oiltight portable steel covers, heavily framed to carry a deck load. A double bottom extends all fore and aft, 3 feet 6 inches deep. Oil fuel is carried in the double bottom and in fore peak tank, while settling tanks for fuel are built in the boiler room and extend to the upper deck. The double bottom abaft the cofferdam is used for carrying feed water and is increased in depth under the engine seat.

Although not classed in any registration society, the hull is strongly constructed. The double bottom has three longitudinals on each side of the centerline bulkhead, the framing being on the transverse principle with deep frames in lieu of webs. The frame and beam brackets are large and box beams are fitted at intervals. In line with the outer coaming of the hatches a box girder is worked above deck with intercostals between the beams and a continuous member below the beams, bracketed to the bulkheads. The shell plating at the forward end has additional strength in the shape of treble riveted seams and closer spaced frames to resist sheering and panting stresses when pitching in head seas.

The vessel has a closed topgallant forecastle, an open bridge, and a closed poop. The doors in the forecastle bulkhead and in the house around the machinery are all watertight.

Accommodations

As will be seen on the plans, the deckhands are housed in the forecastle and have a stairway with a companion

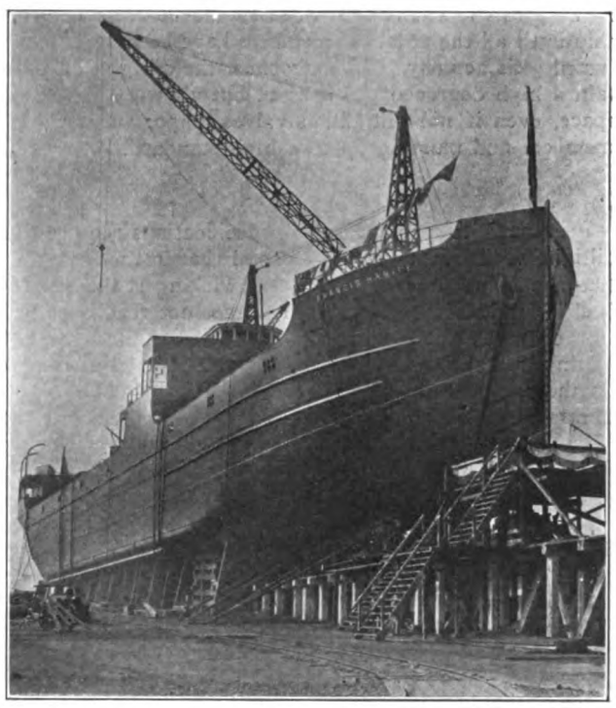

Fig. 2.—Steamer *Francis Hanify* Ready for Launching

on the forecastle head for access when the vessel is carrying a deck load. The deck officers' quarters are in a house on the bridge deck, the pilot house and chart room being above same. The galley, storerooms, cook's, oilers' and firemen's quarters are located in the poop, while the engineers' quarters and dining saloon are in a house on the poop deck. The officers' and crew's quarters are conveniently located and ample provision has been made for their comfort, showers being fitted in all toilets.

Rig and Cargo Handling

The vessel has three steel pole masts and carries sail on the fore and main masts. Each hold is served by two derricks, each 70 feet long, the vangs for the derricks being carried to the head of the mast opposite, while one

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set of vangs has its standing and belaying parts on deck. This arrangement allows a clear space for swinging the lumber while loading or unloading.

The winches, made by Murray Brothers, San Francisco, are of the double drum type, to which the cargo falls are attached, the niggerheads being used for topping lifts, etc. The winches are operated by one man, who stands with the winch at his back, and, being located on a high platform, he obtains a view of his lift during its transit from the vessel's hold to the dock or barge alongside, and

CARGO

The hold and hatches are arranged so that the vessel may carry a lumber cargo, general cargo, or a liquid cargo. An 8-inch main suction pipe, having 6-inch branches into each compartment, is provided, with a suitable cargo pump in the engine room. Provision is made for lumber deck loads as follows: The ends of the forecastle, poop, and sides of the house around the boiler casings are efficiently stiffened on the outside. The bridge deck is 12 feet high, having open ends. The winches are

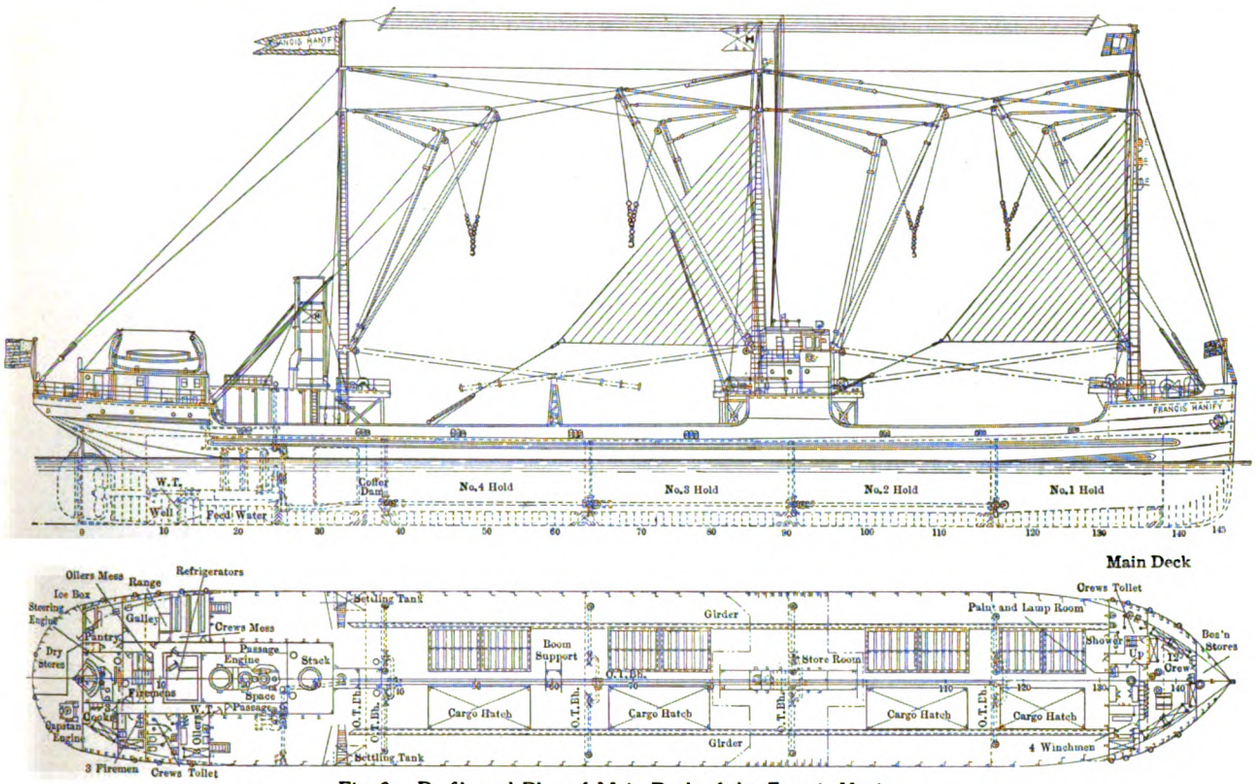

Fig. 3.—Profile and Plan of Main Deck of the *Francis Hanify*

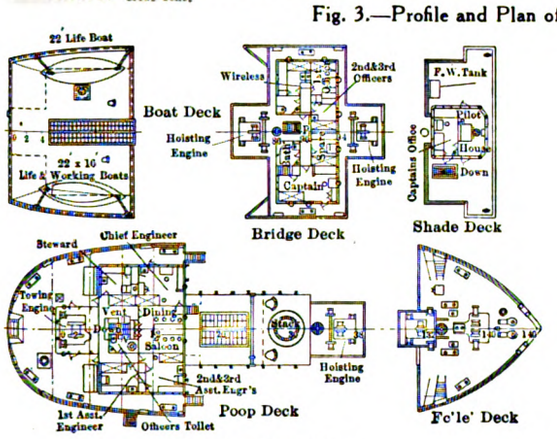

Fig. 4.—Deck Plans

is above the cargo even when the vessel has a deck load on board.

A heavy towing machine, of American Engineering Company's make, is located in the deck house on the poop, with an adjustable towing chock at the rail aft. A warping capstan is placed on the poop, and the steering gear under the poop, the steam gear and the hand gear of which engage directly with the interchangeable tooth rack of the quadrant. The windlass on the forecastle head has large warping ends. The three latter auxiliaries are of the Hyde make.

placed on platforms 13 feet high, while the bulwarks are efficiently braced. A sampson post is built in the after well to steady lumber, and serves as rest for derricks, heavy chain lashings are fastened to chain plates secured to the sheerstrake about 12 feet apart for the length of the open deck and meet over the top of the deck load, drawn tight by rigging screws and provided with chain slips so that in case of necessity they may readily let go.

The vessel is lighted by electricity and has a searchlight fitted on top of the pilot house, but controlled from within. The vessel is also equipped with wireless telegraph, life saving, and all other outfits required by the Rules and Regulations prescribed by the United States Board of Supervising Inspectors.

The *Francis Hanify* can carry 3,500 tons deadweight on a draft of 17 feet 6 inches, and when carrying a deck load the deadweight may run well over 4,000 tons. Fig. 1 shows the steamer *John A. Hooper*,* a similar ship built by the Harlan & Hollingsworth Corporation, when carrying a deck load, the total lumber on board being 2,100,000 square feet taken at an average thickness of one inch. This vessel is 10 feet shorter than the new steamer, and has averaged 12 knots in a loaded condition on a long sea voyage, the average fuel consumption being 7½ barrels of oil per hour. The *Francis Hanify* is expected

* Described on page 72, INTERNATIONAL MARINE ENGINEERING, February, 1913.

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to make 11½ knots under similar conditions with the same machinery.

MACHINERY

The propelling machinery consists of one triple expansion, surface condensing engine having cylinders 21 inches, 34 inches, 56 inches diameter by 42-inch stroke, designed to develop about 1,800 indicated horsepower at 98 R. P. M. The high and intermediate pressure cylinders have piston valves, and the low-pressure cylinder a double ported slide valve, all worked by Stephenson type link motion. Reversing is accomplished by a direct-acting steam cylinder, automatically operated. The condenser is cylindrical in shape, mounted independent of the main engine, the condensing water being supplied by a centrifugal pump worked by a single cylinder engine. The air and two bilge pumps are of the ordinary single-acting type worked from the crosshead of the high-pressure cylinder.

The shafting is of forged open hearth steel, the crank shaft 11½ inches diameter in three interchangeable sections. The thrust shaft has six rings working against a thrust bearing of the horseshoe type.

The propeller is a solid, four-bladed, cast steel wheel, 14 feet 6 inches diameter.

There are two vertical duplex feed pumps 8 inches and 5 inches diameter by 18-inch stroke, which pump the water from the filter tank and discharge it through a feed water heater of the multicoil type to the boilers. There are also independent pumps of the horizontal duplex type, one for the fire alarm system and bilges, one for the wash deck system and bilges, one for the salt water sanitary system, and one for the fresh water system.

The centrifufal pump and the air and bilge pumps were made by Harlan & Hollingsworth, while all other pumps were made by the Warren Steam Pump Company.

Steam is supplied at a working pressure of 180 pounds per square inch by two three-furnace boilers of the cylindrical return tube type, each 14 feet 3 inches diameter and 11 feet 9 inches long. The boilers are arranged for burning crude oil as fuel, the high-pressure or mechanical system being used, the atomizing being done without air or steam. The burners are of the Union Iron Works make. The heating surface in the boilers is 5,000 square feet.

The oil fuel system is very complete, having a special pump for pumping the oil from the double bottom into settling tanks, whence it is pumped through strainers and heaters arranged in duplicate to the burners. Special valves operated from the deck are provided inside the settling tanks for shutting off oil in case of leaks in the fireroom, and the supply of oil to the burners can also be regulated from the deck.

Other auxiliary machinery in the engine room consists of one large cargo oil pump, one one-ton ice-making plant, two electric generating sets, one 12-ton evaporator, distiller, etc. The ice machine was supplied by the Remington Machine Company, the feed water heater, evaporator and distiller by the Griscom-Russell Company, and the generating sets and searchlight by the General Electric Company.

RESOLUTION ADOPTED BY THE INSTITUTION OF NAVAL ARCHITECTS.—At a special general meeting of the Institution of Naval Architects, held on December 8, a resolution was passed providing that all subjects of the foreign countries with which Great Britain is now at war (viz., Germany, Austria-Hungary and Turkey) are suspended from exercising the rights and privileges of membership in the Institution during the continuance of hostilities and until reinstated by special resolution of the Council.

The U. S. Collier Jason as a Christmas Ship

The U. S. collier *Jason,* offered by the United States Government to carry to Europe the Christmas presents given by the various organizations in the United States to the orphans of the countries at war, sailed from New York on November 4, 1914, after having taken on board its package cargo by means of the "marine transfers," with which the vessel is equipped for the rapid handling of coal. This event was noteworthy from an engineering standpoint on account of the fact that one man, with a lever in each hand, hoisted loads at the rate of 400 or 500 feet per minute from the dock, swung them easily over the hatch and dropped them wherever wanted in the hold.

In contrast to this one-man performance, two or three men usually perform the same functions handling package cargo with other methods, in which hoisting speeds of 350 to 400 feet per minute are rarely attained, and then only

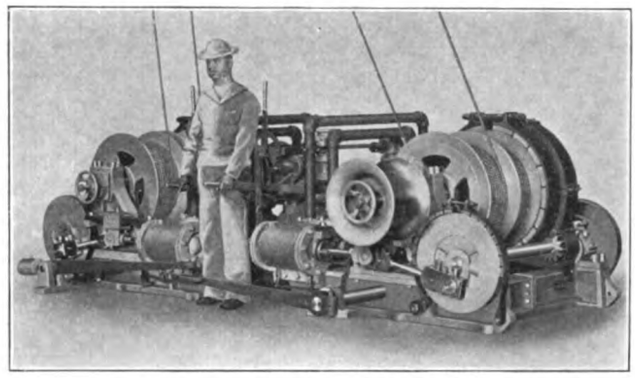

Fig. 1.—Hoisting Winches Controlled by One Man

under favorable conditions. With the "marine transfer" the maximum speed is always utilized because the loads are hoisted or lowered at the center of the hatch or away from the side of the ship, and hence free from all obstructions.

The "marine transfer" permits loads to be landed at several points in the hatch, thus allowing the employment of two or three gangs under each hatch. The stevedores in charge of the loading of the *Jason* were enthusiastic about the system, particularly because the load could be delivered wherever wanted.

THE MARINE TRANSFER

As installed on the *Jason,* the "marine transfer" consists of a series of "A" frame towers, one "A" frame being located between each pair of hatches. The tops of these "A" frames are connected by a girder running fore and aft. On this girder and directly over the center of each hatch is a block through which the fall rope passes. Reaching out on both sides of the vessel are booms, two for each hatch, the outer ends of each pair of booms being in line with the center of the hatch fore and aft. Connecting the outer ends of these two booms are two ropes, each attached to opposite ends of a trolley or swinging block. These two ropes pass around pulleys on the end of the booms and are then led to the drum of the swinging winch. The load fall drops from the overhead block and passes through the trolley or swinging block, terminating in a cargo hook for attaching the load.

The position at which the load is taken or delivered is controlled by the position athwartship of this trolley or swinging block. The hoisting and lowering of the load is

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controlled by one winch operated by a single lever, whereas the swinging block is controlled by a second winch, also operated by a single lever. In a very short time any seaman or stevedore can operate these winches. The load can be taken or deposited at any place from the tip of one outstretched boom to the tip of the other boom. With a little experience, both hoisting and swinging may be carried on simultaneously, thus making the shortest path for the load and the shortest operating cycle.

A ship of the *Jason* type as a freighter for regular package cargo would probably be the fastest ship in the world as regards cargo handling. This statement is borne out by the record made by the *Jason* when coaling the U. S. battleship *Wyoming* in Guantanamo Bay in the spring of 1914.

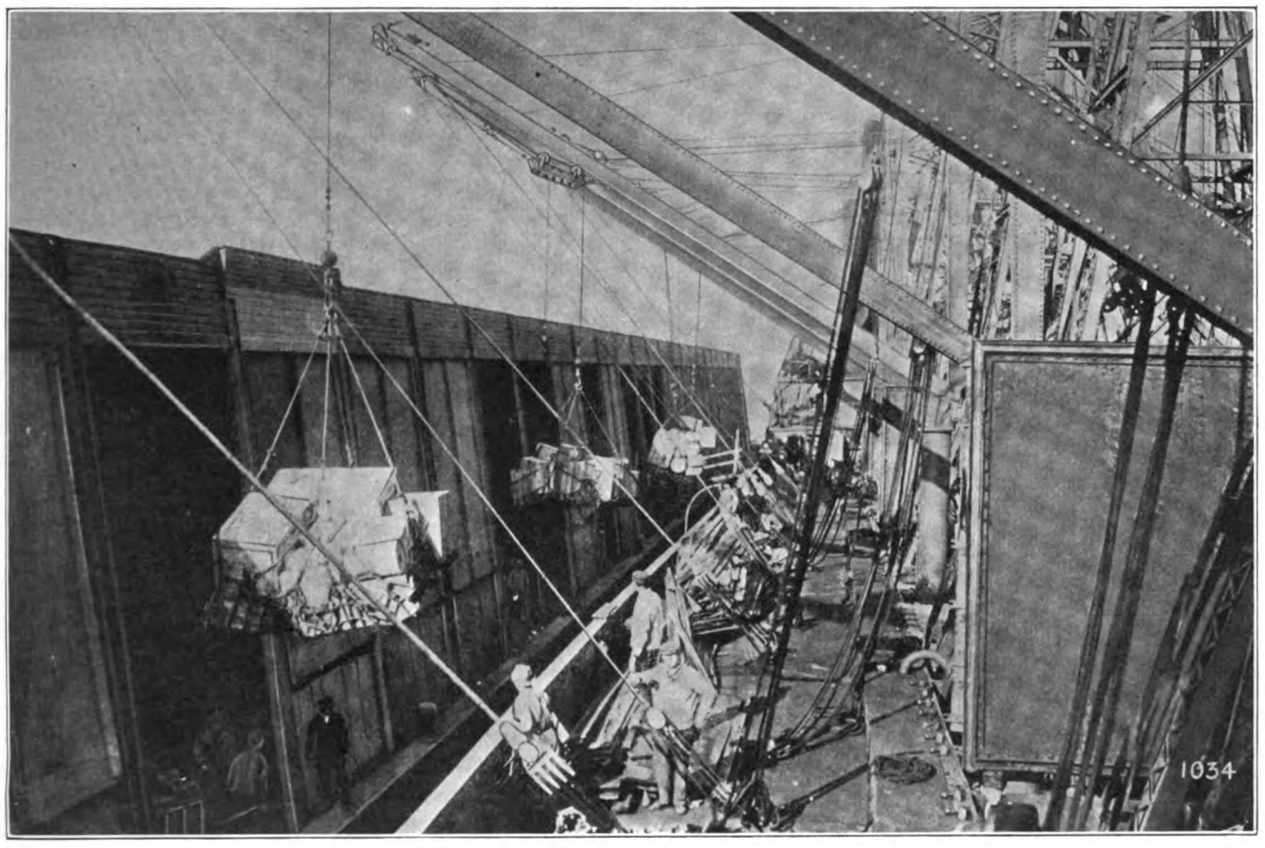

Fig. 2.—The "Marine Transfers" on the *Jason*, Loading the Ship with its Christmas Freight

COALING THE WYOMING

The *Wyoming* was coaled from two naval colliers, the *Jason* and the *Nereus*, both of which are equipped with the most recent types of coal-discharging apparatus. The *Jason* is equipped with twelve "marine transfers," each operated by one winchman. The *Nereus* is equipped with twelve special cableways, each operated by two winchmen. Both discharge with clamshell buckets.

The *Jason* was on one side of the *Wyoming* and the *Nereus* on the other. Both colliers rigged out eight booms over the deck of the *Wyoming*. The *Jason* used her eight booms continuously, dropping coal at eight different points along the deck and through the chutes of the *Wyoming*, while the *Nereus* used six to eight booms, intermittently, on account of breakages.

All was made ready for test the night before—time to get ready not given (usually 20 to 30 minutes' work on the *Jason*). Coaling began at 5.30 in the morning. Coaling stopped at 8 o'clock for breakfast. Coaling resumed at 8.30. The *Jason* cast off at 9 o'clock. The *Nereus* cast off at 9.30 o'clock. The *Jason* delivered to the *Wyoming* a maximum of 465 tons per hour. The *Nereus* delivered to the *Wyoming* a maximum of 433 tons per hour. The *Jason* delivered a total of 1,040 tons in three working hours, an average of 346 tons per hour. The *Nereus* delivered a total of 1,020 tons in three and a half working hours, an average of 292 tons per hour.

From 550 to 600 tons of coal were heaped on board when the colliers left, and it required from 9 o'clock in the morning to 4.30 in the afternoon to clear up and stow the coal left on board. The whole operation of taking on and stowing 2,060 tons of coal was accomplished in nine and a half hours, an average of 217 tons per hour.

Both the *Jason* and the *Nereus* coaling gears are able easily to discharge 100 tons of coal per hatch per hour. In the official trial of the collier *Jason* 137½ tons of coal were actually discharged in one hour with one operator.

At the conclusion of the trial Admiral Badger expressed the opinion that the *Wyoming* could at any time take on 2,100 tons of coal in five hours from two colliers in smooth waters, stowing the surplus left on deck at leisure.

From the above it appears that from one collier the taking on and stowing of 2,100 tons of coal would require approximately ten hours, being an average of 210 tons per hour.

MONTHLY SHIPBUILDING REPORT.—During the month of November 71 vessels of 14,564 gross tons were built and officially numbered in the United States. Four of these, aggregating 8,637 gross tons, were steel steamships. From other sources than construction 10 vessels of 31,221 gross tons were added to the American merchant marine in accordance with the Act of August 18, 1914.

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Shipbuilding in the United States in 1914

Total Output Less than the Tonnage Produced a Year Ago— Largest Output from the Fore River Shipbuilding Corporation

In general, the amount of tonnage turned out by the leading shipbuilders in the United States in the year 1914 was considerably less than that produced in the previous year. The principal exceptions to this, however, were on the Great Lakes, where the Great Lakes Engineering Works produced double the tonnage of last year, and, on the Pacific Coast, where the Union Iron Works completed nearly four times the tonnage of merchant vessels which they produced in 1913.

As shown in Table I, which gives the number, gross tonnage and indicated horsepower of the output from twelve of the leading shipyards in the country, the greatest amount of merchant tonnage was produced by the Newport News Shipbuilding & Dry Dock Company, Newport News, Va. From Table II, which shows the number, displacement and indicated horsepower of naval vessels completed during the year by five of the leading shipyards in the country, the greatest amount of naval construction was completed at the Fore River Shipbuilding Corporation, Quincy, Mass. Combining the merchant and naval tonnage produced by any one yard, it will be found that the Fore River Shipbuilding Corporation stands at the head of the list, with the New York Shipbuilding Company second.

Output of the Atlantic Coast Yards

The largest vessel completed at the Fore River yard was the battleship *Nevada,* of 27,500 tons displacement and 26,500 indicated horsepower. The propelling machinery of this vessel consists of Curtis turbines. The other naval work included a destroyer, also fitted with Curtis turbines; the submarine tender *Fulton* and two submarines, both the submarine tender and the submarines being fitted with Diesel engines supplied by the New London Ship & Engine Company, Groton, Conn. The engine for the *Fulton* was of about 1,000 horsepower and is the largest single Diesel engine so far installed in an American ship. The merchant work turned out by the Fore River yard consisted of the freight steamers *Atlantic* and *Pacific,* which have already been described in these columns. The work now in hand at this yard consists solely of naval work, and includes one destroyer and eight submarines.

TABLE I.—MERCHANT CONSTRUCTION

	No.	Gross Tons.	I. H. P.
Newport News Shipbuilding and Dry Dock Company	5	31,987	15,500
Maryland Steel Company	9	25,045	12,690
New York Shipbuilding Company	8	20,809	9,500
American Shipbuilding Company	4	19,857	6,084
Great Lakes Engineering Works	9	19,598	7,375
Union Iron Works	3	14,072	5,200
Fore River Shipbuilding Corporation	2	11,196	4,200
American Car & Foundry Company	16	10,451	.....
Harlan & Hollingsworth Corporation	5	5,524	4,540
W. & A. Fletcher Company	2	2,806	3,200
Detroit Shipbuilding Company	1	2,072	1,000
Johnston Bros.	5	1,071	580

TABLE II.—NAVAL CONSTRUCTION

	No.	Tons Displacement.	I. H. P.
Fore River Shipbuilding Corporation	5	30,998	46,300
Wm. Cramp & Sons' Ship & Engine Building Company	4	4,037	33,950
New York Shipbuilding Company	1	2,600	9,000
Seattle Construction & Dry Dock Co.	4	2,146	3,350
Bath Iron Works	1	1,010	16,000

The merchant tonnage of the Newport News Shipbuilding & Dry Dock Co., which was the largest total from any yard for the year, included the bulk oil freight steamers *John D. Archbold* and *John D. Rockefeller,* the Mallory freight steamships *Neches* and *Medina* and the collier *Edward Pierce.* The only other work completed during the year consisted of barges and dump scows. The work now on hand, however, includes the battleships *Pennsylvania* and *Mississippi* and the two revenue cutters described elsewhere in this issue.

At the Maryland Steel Company, Sparrows Point, Md., the last three of the American-Hawaiian Steamship Company's freight steamers, the *Washingtonian, Iowan, Ohioian,* of 6,649 gross tons each, were completed during the year, and also four steel dump barges for Panama Canal service, of 1,000 gross tons each, and two steel lighters for the Pennsylvania Railroad. In addition to the ships constructed, three large Scotch boilers were delivered for installation on towboats. There are now under construction at the Maryland Steel Company's yard two colliers for the Panama Canal, of 10,650 gross tons and 7,200 indicated horsepower each.

Although naval construction comprises the bulk of the work now in hand at the New York Shipbuilding Company, Camden, N. J., none of it was completed during the year. There were delivered, however, two large oil steamers of 5,188 gross tons and 2,650 indicated horsepower each for the Gulf Refining Company; the collier *Hampden,* of 4,725 gross tons and 2,100 indicated horsepower, for the Coastwise Steamship Company; the municipal ferry *Mayor Gaynor,* of 1,634 gross tons, for New York City, and four car floats for railway service. The output also included a protected cruiser of 2,600 tons displacement, fitted with Thornycroft boilers and Parsons turbines, for the Greek government. The work now in hand includes the Argentine battleship *Moreno,* of 27,630 tons and 49,300 horsepower, equipped with Curtis turbines; the United States battleships *Oklahoma,* of 27,500 tons and 26,240 indicated horsepower, and the *Idaho,* of 32,000 tons and 37,000 horsepower. The former is propelled by reciprocating engines and the latter by Parsons turbines. There are also four destroyers and the destroyer tender *Melville.* Two large merchant vessels are also under construction, one of which is an oil tanker for the Gulf Refining Company, which is a duplicate of the two delivered during the past year; and the lumber steamer *William O'Brien,* of 5,528 gross tons and 2,000 horsepower.

During the last two years the output from the Jackson & Sharp plant of the American Car & Foundry Company, at Wilmington, Del., has been noteworthy on account of the large tonnage of wooden vessels built. This year the total output amounted to 10,451 tons, which is considerably in excess of the output from any other wooden shipyard in the United States. The tonnage consisted principally of seagoing barges, car ferries and dump scows. At present there is under construction 2,375 tons of dump scows.

The vessels built by the Harlan & Hollingsworth Corporation, Wilmington, Del., included the coastwise oil or lumber steamer *Francis Hanify,* of 2,588 gross tons and 1,720 indicated horsepower, described elsewhere in this issue; the side-wheel excursion boat *Hanover,* for the Louisiana Steamboat & Ferry Company; the double-screw ferryboats *Delaware* and *Weehawken,* the former for the Delaware River Ferry Company of New Jersey, and the latter for the New York Central & Hudson River Railroad Company. This company also built the floating crane

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elevator *Commonwealth* for Philadelphia Harbor Transfer Service, and supplied the machinery for two small wooden steamers, the hulls for which were built elsewhere, and the machinery for a seagoing tug. Marine boilers amounting to 1,000 horsepower were also built for outside purposes.

All of the work completed by William Cramp & Sons' Ship & Engine Building Company, Philadelphia, Pa., consisted of naval vessels, including one submarine, two destroyers and the gunboat *Sacramento*. The work now under construction includes the two turbine passenger ships *Great Northern* and *Northern Pacific*, of 8,255 gross tons and 25,000 horsepower each, described in our December, 1914, issue; the car ferry *Henry M. Flagler*, for the Florida East Coast Railway, and five destroyers for the United States Navy. All of these vessels, either built or building, with the exception of the car ferry, are equipped with either White-Foster or Babcock & Wilcox watertube boilers.

The W. & A. Fletcher Company, Hoboken, N. J., completed during the year two ferry boats for the New York Central & Hudson River Railroad. These vessels were sister ships of 1,403 gross tons and 1,600 horsepower each. At the Bath Iron Works one United States destroyer and the racing yacht *Defiance*, for the Tri-City Syndicate, were completed, while one other destroyer is now under construction The output of the Staten Island Shipbuilding Company, Port Richmond, New York, for the year, which amounted to 702 gross tons, consisted of three tugs. This company now has in hand four other tugs aggregating 1,380 gross tons.

In Baltimore, the Skinner Shipbuilding & Dry Dock Company completed two tugs, and the Spedden Shipbuilding Company, a steel fire-boat for the city of Baltimore. The former company has in hand a self-propelled seagoing suction hopper dredge of about 500 gross tons for the United States Army Engineers, and the latter company, a steel screw lighthouse vessel and a steel dredge for the United States Army Engineers.

Other work completed during the year consisted of a tug-boat built by the Lake Torpedo Boat Company, Bridgeport, Conn.; two barges by the Johnson Iron Works, Incorporated, New Orleans, La.; five dump scows and a dredge hull by John H. Mathis & Co., Camden, N. J.; and a 90-foot derrick lighter built by the Thames Towboat Company, New London, Conn.

SHIPBUILDING ON THE GREAT LAKES

Both the American Shipbuilding Company and the Great Lakes Enginering Works, Detroit, Mich., produced about 20,000 tons of shipping during 1914. The vessels built by the American Shipbuilding Company included the bulk freighter *Howard M. Hannah, Jr.*, of 6,204 gross tons and 1,760 horsepower, built at Cleveland; the bulk freighter *Robert L. Ireland*, of 6,387 gross tons and 1,600 horsepower; the bulk freighter *William D. Crawford*, of 6,385 gross tons and 1,800 horsepower, and the sand sucker steamer *Kelley Island*, of 881 gross tons and 924 indicated horsepower, all built at Lorain. The output of the Great Lakes Engineering Works included the passenger steamer *South American*, of 2,662 gross tons and 2,500 horsepower, for the Chicago, Duluth & Georgian Bay Transit Company; a bulk freighter of 6,311 gross tons and 1,800 horsepower; a lumber steamer of 1,815 gross tons and 700 horsepower, and a special type of self-unloading freighter, the *Huron*, of 4,810 gross tons and 1,775 horsepower, for the Wyandotte Transportation Company. The company also completed four producer-gas coal barges of 1,000 tons capacity each for the Alabama & New Orleans Transportation Company.

While a number of other vessels were built on the Great Lakes, their tonnage for the most part was small. One of the largest was a freighter of 2,072 gross tons and 1,000 horsepower built by the Detroit Shipbuilding Company, Detroit, Mich., for the George Hall Coal Company. Johnston Bros., of Ferrisburg, Mich., built a small passenger vessel equipped with an oil engine of the semi-Diesel type, as well as two tugs and two electric dredges for the Yuba Construction Company. The Manitowoc Shipbuiilding & Dry Dock Company also built two tugs, a hydraulic dredge and a dipper dredge. Two ice-breaking tugs fitted with Kingsford boilers and high-pressure engines were built by the Cowles Shipyard Company, Buffalo, N. Y., and this company now has in hand a ferry tug of 150 horsepower for the Tonawanda & Grand Island Ferry Company.

WORK IN THE PACIFIC COAST YARDS

The largest output on the Pacific Coast was by the Union Iron Works, San Francisco, Cal., where two large oil tankers, the *Frank H. Buck* and *Lyman Stewart*, both of 6,076 gross tons and 2,600 horsepower, were delivered, the former to the Associated Oil Company and the latter to the Union Oil Company. A 116-foot oil barge with a capacity of 2,060 barrels was also built for the Standard Oil Company. Three submarines were completed for the United States Navy, and a large caisson, 113 feet 10 inches long by 36 feet beam by 65 feet depth, was built for the Isthmian Canal Commission. The Union Iron Works now has under construction for the Standard Oil Company an oil tank steamer of 6,000 gross tons and 2,600 horsepower.

At the yards of the Seattle Construction & Dry Dock Company, Seattle, Wash., all of the work built or building was for the United States Government. Three Government tug boats of 250 gross tons and 800 horsepower were completed, and also one submarine. The only vessel now under construction at this yard is the submarine tender *Bushnell*, of 2,500 gross tons and 2,500 horsepower. This vessel is to be fitted with Yarrow watertube boilers and geared turbines.

Two vessels, one a steel lumber and oil steamer of 1,319 gross tons and 1,000 horsepower, and the other a steel suction dredge with the hull 140 feet long, were built by the Craig Shipbuilding Company, Long Beach, Cal., where there are now under construction two submarines of the Lake type fitted with Busch-Sulzer Diesel engines.

SHIPBUILDING IN THE NAVY YARDS

A greater amount of shipbuilding work is now in progress in the Government navy yards than ever before in the history of the new Navy. During 1914 the Secretary of the Navy authorized new construction work at three navy yards which hitherto have not undertaken the construction of vessels. Formerly ship construction was carried out only at the New York Navy Yard, Brooklyn, N. Y., and at the Mare Island Navy Yard, San Francisco, Cal., but now, in addition to the battleships *Arizona* and *California*, which are being built at the New York Navy Yard, and the fuel ships *Kanawha* and *Maumee*, building at Mare Island Yard, work has begun on the construction of a submarine at the Portsmouth Navy Yard, Portsmouth, N. H., on the supply ship *No. 1*, at the Boston Navy Yard, and on the transport *No. 1*, at the League Island Navy Yard, Philadelphia, Pa. Construction on these vessels, however, was delayed for over a year on account of the necessity for installing new machinery and equipment before the work was begun.

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One Hundred Percent Efficient, Yet Obsolete

That the only merchant sailing-vessel rig known to this continent which presents the acme of efficiency in operation should become extinct is passing strange; yet in the 60-ton centerboard New Brunswick schooner *Gold Finder* is seen one of the last survivors of such a vanishing type.

The *Gold Finder's* rig consists of two pole masts, fore and main sails and no bowsprit. Under no conditions can any portion of her sail area be blanketed by another part. With the wind from any quarter her entire spread of canvas is bound to draw. All her sails can be furled from the deck and going aloft is unnecessary. The men can easily navigate her.

Her hull, too, is the height of simplicity in naval architecture. She is apple-bowed and box-sterned, with no overhang at either end to speak of. Her rudder is hung "out-of-doors," as on an overgrown rowboat. Well along in years, and built of inexpensive spruce, to-day $400 (£82) is a conservative estimate of the *Gold Finder's* worth; yet she is capable of carrying an 80,000-foot cargo of lumber from New Brunswick to Boston in a week, and getting $3.50 (14s. 7d.) per thousand for her trouble much of it obviously would be clear profit.

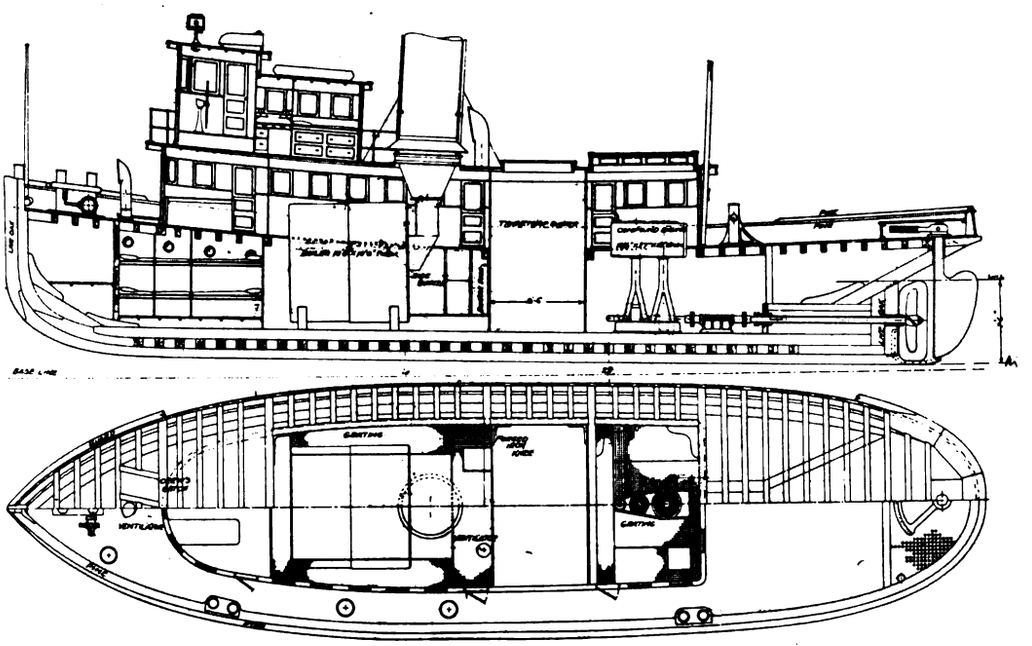
The *Gold Finder* is one of the original St. John woodboats, which used to be seen on the New England coast in hordes, and which tradition says came west out of the fog and gloom of the Bay of Fundy, with muskrats perched on the rudder heads! Formerly these craft were given "bald-headed" rigs, in order to obviate housing topmasts when passing under bridges on the St. John river, but in later days the Provincial coasters have become Americanized to the extent of adopting headgear, topmasts and stern overhangs.

At present the *Gold Finder* is one of a small fleet of down-easters engaged in carrying cord-wood from Beaver Harbor, N. B., for consumption in the lime kilns at Rockland and Rockport, Me. She is, however, one of the last of this type of vessel and her days of usefulness are probably about over. She will undoubtedly be superseded by motor craft.

Shallow Draft Wood-Burning Tug

The illustration shows an 87-foot tug now being built from plans by J. Murray Watts, of Philadelphia, for the Poitevent & Favre Lumber Company, of Mandeville, La. This design is interesting, as it shows a tug adapted to the local conditions, which require a boat of good power and seaworthiness for use along the Gulf of Mexico, and at the same time the draft is limited to 7 feet 6 inches on account of some of the tows calling for navigation of inland waterways. To get this shoal draft, very good beam is required and 22 feet for the molded beam was found to be satisfactory.

The question of fuel came up, and it was found that wood fuel was about one-half the cost of coal. Therefore it was decided to use wood, and for this reason the bunkers are unusually large, there being an athwartship bunker 8 feet 6 inches long in a fore and aft direction which allows two lengths of 4-foot wood to be piled therein. Besides this, the regular side bunkers are fitted as usual and the wood in these is carried as a reserve.



General Arrangement Plan of 87-foot Tug

The machinery equipment consists of a Scotch boiler with two furnaces adapted for burning wood, the diameter of the boiler being 10 feet 6 inches and the length 10 feet 8 inches. The engine is a fore and aft compound, 13½ inches and 27 inches by 18 inches stroke, developing 300 horsepower. There is a complete electric lighting plant with a 5 kilowatt turbine-driven generator, giving sufficient current for the incandescent lamps and a 14-inch arc searchlight.

The Poitevent & Favre Lumber Company furnished all the lumber for the hull, and naturally this is of the finest quality; the stem, keel and sternpost being of live oak, the frames being 5-inch by 10-inch double, spaced 22 inches, and the planking varying from 3½-inch to 2½-inch cypress.

TRIAL TRIP OF THE GREAT NORTHERN.—The new Pacific coastwise liner *Great Northern*, which was described in our last issue, underwent her official trials recently over the Rockland course, attaining a speed of 24.7 knots, or 1.7 knots in excess of her designed speed.

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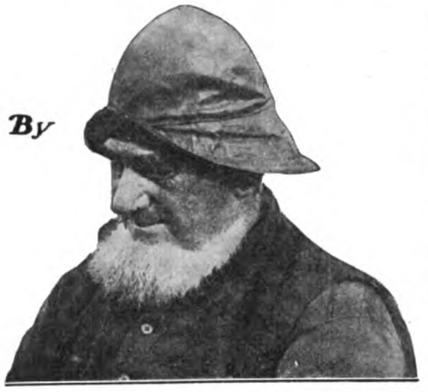
Economy Talks By "Old Scotch"



Economical Use of Electricity for Lighting

There are ways to save money on shipboard other than those connected with the making of the steam. The economical using of it is quite as important, but in this connection the savings are smaller and they come from attention to small details. But, as my Scotch friend says, "Many a mickle makes a muckle," so it is well for us marine engineers in these piping hard times to watch the spigot as well as the bunghole.

Since the days of the scriptural injunction, "Let there be light," mankind has found it quite a task to furnish artificial light to carry on the work when natural sources of light are cut off. On the modern steamship lighting has reached such a stage that all parts of the machinery spaces are very easily made almost as light as day. When I first went to sea we had to put up with old, smoky kerosene (paraffin) bulkhead lamps and petticoat lamps burning the extract of hog fat. These lights would generally go out at the most critical times, and they were a darned nuisance at all times. Nowadays almost any old steam packet, from a harbor tug up, is furnished with a dynamo, and the lighting question is easy; in fact, it is so very easy that I am afraid that many of us overlook the fact that it costs money to keep the light burning. True, we do not have to buy any lamp oil or wicks, but do not forget that we are using up steam, steam means coal, and coal means money and lots of it at times. I went aboard a 2,500-ton coasting steamer to see an old friend of mine recently, and the first thing that struck me was that carbon lamps were being used all over the ship.

Now in these days the use of carbon lamps is simply a crime perpetrated on the coal pile, and there is no excuse for it. When these new-fangled Tungsten or Mazda lamps, or whatever else they call them, first came out, I looked on them a little bit shy, as they cost like the dickens and would break very easily. But, gee whiz! they don't cost much more than carbon lamps during the last year or two, and they stand the racket much better. To get down to the scientific dope on the subject, I find that for the voltage we use on ships the electric juice necessary for a carbon lamp amounts to 3.1 watts per hour, or 49.6 watts for an ordinary 16-candlepower lamp. With a Mazda lamp we only use 1.25 watts per candlepower each hour, or in a 32-candlepower lamp we only use 40 watts of current per hour. In other words, we get twice as much light for only 80 percent of the current used. If the use of carbon lamps these days doesn't constitute a crime, in view of the dope on the subject, I don't know what does. Yet there are a whole lot of people still using carbon lamps. The only use for carbon lamps on a ship now is possibly in hand portables, as the Tungsten filaments do not stand the hard knocks quite as well as carbon.

Mazda lamps are generally good for 1,000 hours' use on an average, but you cannot depend on carbon lamps for much more than 600 hours. As a matter of fact, most people use lamps too long, anyhow. It costs much more to operate lamps giving a dull light than it does for those giving a bright light. A good rule is to put in a new lamp after the old one has fallen off about 20 percent in its efficiency. As soon as the bulb begins to look a little smoky on the inside, then is the time to douse it.

Of course, it is hard to give a general rule for the cost of electric light, as the cost of fuel and the efficiency of the plant vary so much, but it is safe to say that on an average it costs one-half a cent (¼d.) to run one lamp one hour. That isn't very much in itself, but when you multiply it by four or five hundred it runs up into real money.

It always gives my economical disposition a severe jolt to see so much carelessness as there is in using electric lights. Many a time they are allowed to burn in places which no one is using, or left to burn when there is plenty of good daylight to see everything distinctly. People never think of turning out electric lights in their rooms when they leave them, notwithstanding the fact that when they were youngsters they were brought up to use oil lamps, and to "douse the glim" every time they went out of the room. They have grown careless and have an idea that electric lights do not cost anyhing. Of course, in cleaning boilers the dynamo should be run to let the poor devils inside have all the light they need, but that is no reason why every light in the whole machinery space should be turned on full tilt.

Speaking of cleaning boilers, what a blessing is this electric juice compared to the time when we had to use hand lamps burning lard oil! I can remember every time after I got through working two or three days inside of a boiler that I would cough up enough lampblack out of my throat and lungs to mix a pot of black paint.

While we are talking about petticoat lamps, or hand lamps, whichever you choose to call them, there seems to be a few of them used on some ships yet. They stand rougher handling than the ordinary portable electric lamp, and are still used in coal bunkers, etc. Kerosene (paraffin) is dangerous to use this way, so a great many people use lard oil. Pig products have gone up with the cost of living, so we have to pay from $1.25 (5s. 2d.) to $1.50 (6s. 3d.) per gallon for this kind of oil, which is a quite expensive luxury. There are several kinds of substances like paraffin which can be bought on the market for from six to ten cents (3d. to 5d.) per pound, which make a mighty good substitute for lard oil, and are now used quite extensively in hand lamps. It has to be melted to run into the lamps, and when it is well lighted it burns with but very little smoke and is not put out by drafts any quicker than oil lamps. On an ordinary-sized ship the use of this substance results in a considerable monthly saving.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Q.—What is a reasonable efficiency of propulsion for a moderate speed coastwise steamer? L. P.

A.—A ratio of effective horsepower to indicated horsepower should be realized is 50 percent.

Q.—How great a length is allowable in condenser tubes without putting in an extra tube sheet for preventing distortion? T. E. B.

A.—One hundred diameters for tubes held by ferrules and corset-lacing packing, one hundred and twenty diameters when held by tight wooden ferrules.

Q.—Are jet condensers ever used with turbines when fresh water is available for the circulating water? W. O. C.

A.—Jet condensers should never be used. High vacua are essential to good efficiencies in turbine plants and jet condensers of any type are unsuitable for the production of high vacua. A large quantity of air in solution is carried in with the condensing water; this is liberated in the condenser and is equivalent to a very large air leakage. The air pump has to withdraw this enormously augmented volume of air and cannot be made of sufficient size. No form of condenser in which the condensing water mixes with the condensate is suitable for the production of high vacua.

Q.—Will you kindly tell me why the thrust block in marine turbines is sometimes located at the forward end of the turbine and sometimes at the after end, and which is the better location? T. B.

A.—In the Parsons type the thrust block is invariably located at the forward end, as it is then nearer the dummy rings by which the adjustment of the turbine is gaged. If it were at the other end of the turbine the expansion in the shaft between the thrust block and the high-pressure dummy rings would be sufficient to make the adjustment of clearances uncertain. In the Curtis type where axial clearances are much greater this is not so essential and frequently the thrust block is located at the after end of the turbine in order to have it further away from the high temperature of the high-pressure steam which by conduction along the shaft imparts a temperature to the thrust bearings much higher than that due to the friction of the thrust alone. However, the present tendency for the Curtis is toward the forward location.

Q.—What is the thermal efficiency of a turbine operating between 180 pounds gage and 28 inches vacuum, with 130 degrees of superheat in the steam chest? Will the efficiency be materially increased by raising the steam chest pressure to 250 pounds? S. T.

A.—The efficiency for Rankine's cycle from 195 pounds (absolute) and 130 degrees superheat to 1 pound (absolute) is 30 percent, and for 265 pounds (absolute) and the same superheat to 1 pound (absolute) it is 31.6, so there is a gain of but a little over 1½ percent by this big increase in pressure. The gain from increasing the vacuum is, however, much more marked, as, for example, increasing the vacuum 0.8 inch to 28.8 inches increases the thermal efficiency from 30 percent to 34½ percent. This is not merely of academic interest, as the actual steam consumption tests of turbines in operation show very nearly the full theoretical gain when the vacuum is increased, as is plain from the following table.*

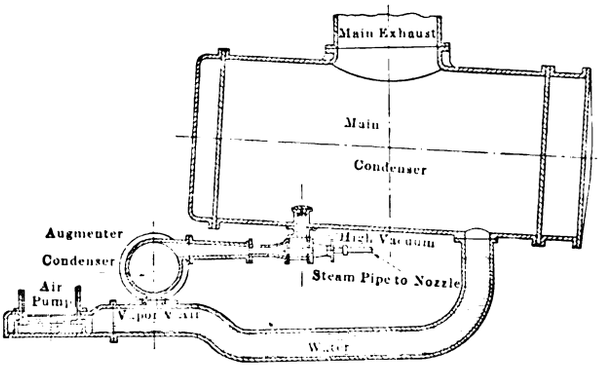
STEAM AT 200 POUNDS AND 200 DEGREES SUPERHEAT

Increase of Vacuum	Theoretical Saving in Steam Percent	Actual Saving in Steam Percent
27 inches to 28 inches.....	6.8	5
28 inches to 29 inches.....	11.4	8
29 inches to 29½ inches.....	16.0	6.6

All of which strongly emphasizes the necessity of infinite care and attention being devoted to the condenser end of a turbine installation.

Q.—Please explain the principle and operation of a vacuum augmenter, as is used in Parsons' trubine installations and why do not other turbines have them? A.

A.—There is a great gain in thermal efficiency by increasing the vacuum (see previous question), so that in turbines where it is mechanically possible to work with the large specific volume attendant upon low-pressure it is



Vacuum Augmenter

desirable that the highest vacua be maintained. Air leakage in a condensing system has an enormously disturbing effect upon the vacuum, as, regardless of the steam condensed, the air remains and being at low-pressure has a large specific volume, so that the removal of a normal leakage must be effected by air pumps of large volumetric capacity. Moreover, for very low-pressures the specific volume increases at an extremely rapid rate, so that a small air leakage may require large volumes to be removed, in order that the rate of removal equal the rate of leakage. It is the handling of these large volumes of very low-pressure air which is difficult for the ordinary type of air pump. The air leakage may be handled by a vacuum augmenter invented by Sir C. A. Parsons and shown in the accompanying sketch. This is essentially a device for removing the very low-pressure air and compressing it to a specific volume that can be handled by the common type of air pump. Here the air pump inlet is placed about 4 feet below the lowest point of the condenser. As a consequence, the pressure at the air pump is greater than that in the condenser by about 2 inches of mercury. Hence the same weight of air can be removed by a much smaller pump. The condensed steam

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* From a paper by G. S. Swallow, Transactions of Northeast Coast Institute of Engineers and Shipbuilders.

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enters the air pump by the bent pipe, but the air is drawn off by a steam jet situated as shown. This discharges into an auxiliary condenser, which drains to the air-pump inlet, as indicated. The volumetric capacity of the steam jet is very great, and unless the air leakage is serious, a vacuum a little below the theoretical can be continuously maintained in the main condenser.

An equivalent device is the fitting of "wet" and "dry" air pumps. The wet pump is intended to handle condensate only and is of the common duplex type and located below the condenser, as in the case of the "vacuum augmenter." The "dry" air pump is intended solely for air or vapor, and takes the place of the ejector of the "augmenter" both in function and location, though the pump itself is frequently higher. The "augmenter" will give the lowest vacuum, but it is at an expenditure of steam of about 1½ to 2 percent of the total steam consumption, whereas the "wet"-"dry" pumps will give nearly as good a vacuum at a considerably less steam consumption, and are mechanisms with which the regular operating force is thoroughly familiar. Probably this accounts for the fact that in most of the newer installations, except where extreme refinement is attempted, the wet-dry pumps find more favor.

Q.—Will you please give me a solution of the following problems. The towboat (S) has two tandem compound condensing engines, 28 inches by 63 inches by 12-foot stroke; boiler pressure, 200 pounds; revolutions per minute, 10. The approximate indicated horsepower, 3,750. The wheel is a simple radial paddle wheel, located at the stern, 36 feet diameter, 40 feet long with buckets 40 feet by 4 feet. What horsepower would be delivered by this wheel? What would be the result if the number of revolutions were increased to 20, and what would be necessary in order to increase same?

A.—If the indicated horsepower of 3,750 which is given is correct, it is probable that the effective horsepower which the paddle wheel delivers and which is used in overcoming the resistance of the hull is about 45 percent of this, or about 1,690 horsepower. It is doubtful, however, if an engine of the type and dimensions given would have such a high indicated horsepower at 10 revolutions per minute, for if we assume cutoff in the high-pressure cylinder as occurring at 8/10 the stroke and a mean effective pressure factor of .7, which is reasonable for this sort of engine, the number of expansions (n) is

$$\frac{(63)^2}{0.8\,(28)^2} = 6.34,$$

and the theoretical or hyperbolic

$$M.\,E.\,P. = P_{boiler}\,(1 + \log_e n)\,\frac{1}{n} - P_{back} = 215\,(.45) - 4 = 92.7 \text{ pounds.}$$

Probable $M.\,E.\,P. = 92.7 \times .7 = 64.9$

" $I.\,H.\,P. = \dfrac{2 \times 64.9 \times 12 \times 3117 \times 10}{33{,}000} = 1470$ (per engine) $1470 \times 2 = 2940 =$ total $I.\,H.\,P.$

(If the high-pressure cutoff occurs at .6 stroke this becomes 2,400.) This would give $2{,}940 \times .45 = 1{,}320$ as the effective horsepower at 10 revolutions per minute.

In general the horsepower increases as the cube of the speed for the speeds generally encountered, and except for the increase in slip which may be considerable for a large change of revolutions per minute the speed increases directly proportional to the revolutions. For the case in hand, therefore, doubling the revolutions per minute would nearly double the speed of the boat (assuming no changes occur in loading or trim) and would require about eight times the indicated horsepower, which would require a new engine. If, however, the same boat were so loaded that the speed were the same with the increased revolutions per minute, the power necessary would be more nearly proportional to the product of slip, and $(RPM)^3$, for example, if the present boat were to be so loaded that her speed were the same as when operating light at 10 revolutions per minute the power under the new conditions would be increased in the proportion

$$\frac{20^3 \times \text{slip (new)}}{10^3 \times \text{slip (old)}}$$

and if 25 per cent were the original slip the new slip is 62½ percent, and the power necessary would be

$$\frac{20^3 \times 62.5}{10^3 \times 25} = 9 \text{ times as great.}$$

Q.—It is necessary to push six barges of a total displacement of 15,000 tons up stream at the rate of five miles per hour against a five-mile current. Said work to be done by a boat 200 feet long, 40 feet beam and about 6 feet 6 inches draft. The block coefficient of the hull is about .75 to .80. What indicated horsepower would be necessary to accomplish this? Could I use the formula $\dfrac{D^{2/3}\,V^3}{C}$ in this case, taking the value of C from the performance of the steamer mentioned above? The dimensions of the barges would be 250 feet by 50 feet by 8-foot draft. The principal dimensions of the steamer are 275 feet by 61 feet by 6-foot draft. Would the work up stream against a five-mile current be the same as a speed of 10 miles in still water? T. B.

A.—If the coefficient C in the equation $I.\,H.\,P. = \dfrac{D^{2/3}\,V^3}{C}$ is derived from a similar ship doing work similar to that intended for this boat, this is an excellent method for determining power. D. W. Taylor * proposes for paddle-wheel boats

$$I.\,H.\,P. = \frac{A\,V^3}{K}$$

where V = speed in knots, A = area of two floats (one on each side) in square feet, and K is a coefficient depending primarily upon slip.

If for the case in hand K be derived from trials under similar conditions it would be directly applicable to the new design. There are no data available for estimating the indicated horsepower of a case as given above out of whole cloth. The best estimate could be made upon the results of trials at the experimental basin at Washington, using scale models of the towboat and her tow.

Q.—Would the following data be suitable for a small yacht engine of 75 indicated horsepower? Cylinder diameters, 3½ inches, 5⅞ inches and 10 inches; stroke, 7 inches; boiler pressure, 250 pounds; revolutions per minute, 430; back pressure, 4 pounds; mean effective pressure, 53 pounds; cut-off, .75; efficiency factor, .70; ratio of expansion, 11; clearance, 0.4; piston speed, 600 feet per minute.

A.—Some of the data are inconsistent as piston speed, stroke and revolutions per minute. We will accept the piston speed and stroke and disregard the revolutions per minute. The cylinder proportions are consistent with good practice. The efficiency factor and mean effective pressure are higher than would probably be the case for this engine, therefore take an efficiency factor of .60; the solution for indicated horsepower then becomes:

Pressure at admission 250 gage + 15 atmos. — 5 loss in line = 260 pounds P_1.

Theoretical mean effective pressure $= P_1\left(\dfrac{1}{n} + \dfrac{\log. n}{n}\right) - P_b$, when P_b = back pressure and n equals number of expansions. $260 \times .30 - 4 = 74$ pounds per square inch.

Probable mean effective pressure = theoretical mean effective pressure × efficiency factor, $74 \times .60 = 44.4$ pounds per square inch.

$$\text{Probable indicated horsepower} = \frac{600 \times 44.4 \times 78.5}{33{,}000} = 63.3.$$

To get the 75 indicated horsepower desired it will be necessary to increase the piston speed to 712, which is entirely allowable. This gives revolutions per minute, 610. If these revolutions per minute can be accepted the engine is suitable.

* Speed and Power of Ships.

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Letters from Marine Engineers

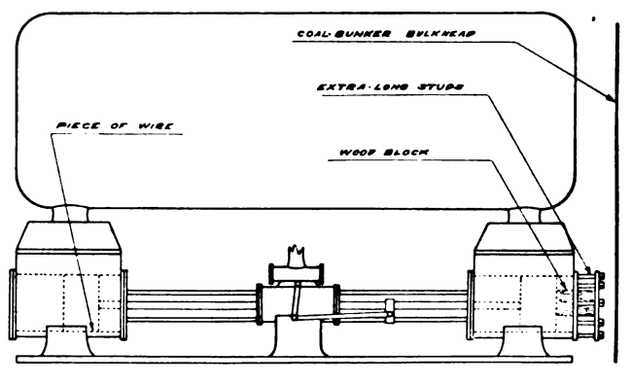
Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries — Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

Valve-Spring Jams Pump-Piston

While a certain steamer was passing through the St. Clair flats, Lake St. Clair, the pumps on the condenser suddenly stopped. The condenser was of the horizontal surface type, the circulating pump and air pump being on the same piston rod and having a common steam cylinder as shown in the sketch. We attempted to start the pump again, but were unsuccessful, and so immediately shut down the main engine and began investigations to attempt to locate the cause of such a sudden stop.

The steam cylinder and valve mechanism were carefully examined and found to be in the proper condition. The valves on the air end were all overhauled and no defects



Repairs to Air Pump

were visible there. The valves of the circulating end were then examined and the brass spring in one of the valves was found to be broken and quite a fair sized piece missing. The rest of the valves being in good condition, the only possible conclusion we could arrive at was that a piece of this broken spring had become lodged in between the cylinder and the piston and thus caused the sudden stop.

In order to remove the spring, it was necessary to remove the piston and packing, and to do this we had to first move the piston to the end of its stroke. We turned on the full head of steam in the steam cylinder, and by means of long bars attempted to aid the steam in forcing it over, but we were unsuccessful.

The air end of the pump was about a foot from the coal bunker bulkhead, so that it was possible to rig up a jack screw against the bulkhead and the piston of the air end. This was done and an attempt was made to force the piston over. As soon as pressure was applied to the jack screw, the bulkhead bulged and did not form a strong backing for the jack screw. Therefore this method was given up.

To accomplish our purpose, we then removed the cylinder head from the air end and took about half of the studs out of the cylinder casting and replaced them by long studs about 8 inches in length with a comparatively long thread on the outer ends which we made for the occasion. We then took an oak block of convenient length and placed it between the piston and the cylinder head, as shown in the sketch, and then by screwing up the nuts on the long bolts, we were able to force the piston over by very small amounts at a time. Pieces of wood were inserted between the piston and the block as the ends of the threads were reached. After getting the piston over and removing the follower and packing, we got the piece of spring out and then put the pump in working condition and proceeded on to Detroit after a delay of two hours caused by a piece of brass wire one and one-half inches long.

A. L. F.

Unique Pump Repair

While the writer was on the tank steamer *L*——— our auxiliary condenser stopped one night, and when taken apart the next day it was found that the nut on the piston rod in the steam cylinder had worked off the thread, leaving the follower and piston rings all adrift in the cylinder.

The condenser and pumps were of a regular standard make, with circulating pump in one end, air pump in the other end, and steam cylinder in the middle. The nut, after working loose, had upset the thread on the piston rod, and try as we could we could not get the nut started on the rod again, so we had to take the piston rod out. This, of course, meant to disconnect and remove pistons and packing in both air and circulating pumps.

After we got the piston rod out we found that it was also bent, and that the bend was a short one right in the threaded part next to the steam piston. It was a nasty bend to get out, as there was no lathe on board the vessel. We wanted the condenser again as soon as possible, so we soaked our heads to think out what could be done.

We decided on rigging up two centers on the tank top on deck. The centers were made of two common set screws 5/8 inch by 3 inches, ground to a point and screwed through an angle bracket made of 5/8-inch by 2½-inch flat iron. After we had the brackets and set screws finished, they were clamped on the tank top with two C clamps. The old centers in the piston rod were found, cleaned out and the rod put up on the improvised centers and turned over.

We found it to be worse than we had expected, as it had two kinks instead of one. It was marked, taken down and put between two hardwood blocks and straightened by the slow process of alternately pounding between the blocks and testing it between centers. It could not be straightened between centers, as they were too weak to stand any hammering.

After half a day was spent in pounding and trying the rod between centers, we had it true. The steam piston was then driven on the rod, to be used as a pulley. A belt was made from marline in the form of a flat sennet.

Next came our motive power to drive our improvised lathe. This was in keeping with our lathe and consisted of a fireman turning a grindstone, the box of which stood on end and the marline belt passed over the grindstone and on to the piston pulley.

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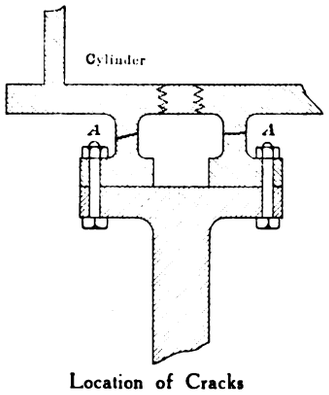
A chasing tool was made out of an old flat file and the burred up and damaged thread on the piston rod was rechased. A little filing finished up the thread, and also smoothed up the rod, taking all the hammer marks out of it. The rod was then put back and the pumps reassembled. This arrangement was running satisfactorily three years afterward when the writer left the vessel. J. J. F.

Repairs to a Cracked Cylinder

A new tugboat had been in commission during the summer and was laid up when ice began to form in the river on which she had been operated. The engineer was particular about draining all the pipes, valves, fittings, cylinders, etc., as no steam was to be kept on the boat while out of commission. In the following spring everything appeared to be in good shape when the engineer started to get the boat ready, but, on turning the engine over at the dock under steam, the foot of the low-pressure cylinder, where it rested on the column, was found cracked. The sketch, a sectional view of this side of the cylinder, shows the cracks at the places marked *A*. Knowing that this foot was not cracked when the boat went out of commission, the engineer began an investigation in order to discover the cause of the damage. This disclosed the fact that the foot had been cast hollow, with a flange on the inside of it, as shown in the sketch, thus requiring a core to make the hollow.

This core extended through the bottom of the cylinder and the hole had been closed by tapping it out and screwing a wrought iron plug in it. The plug had not been made perfectly tight and water had leaked through it during the time the boat had been running, so that the



Location of Cracks

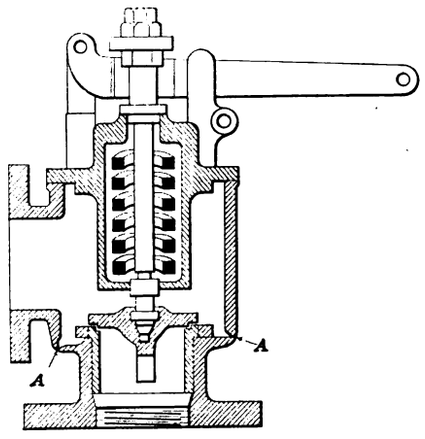
foot on the cylinder was filled with water at the time she went out of commission. This water soon formed into ice and, in expanding, did the damage. Fortunately the damage was done in places that could be easily patched, but if the bottom of the cylinder had cracked the probabilities are that a new cylinder would have been required.

The draftsman who designed this cylinder blundered. If the foot had been designed without the inside flange, which was of very little value, no core would have been required in the mold and the bottom of the cylinder would not have had the hole in it. Perhaps, if the plug had been made of cast iron, it would not have leaked, but no matter how tight the wrought iron plug was fitted it was bound to loosen in the hole enough to allow some leakage, the expansion and contraction of the two metals not being equal.

When the foot had been patched a drain hole was drilled in the side close to the bottom so that the water that leaked in would not accumulate. J. S.

An Unusual Accident to a Safety Valve

A very unusual accident occurred some years ago to the safety valve on the boiler in a tugboat. The boat had left port without a tow, and soon after the fireman noticed steam leaking around the valve. He reported it to the chief engineer, who was on deck, although not on watch. Going into the fireroom the chief grasped the top of the valve to pull himself up on the rounded top of the boiler and, as his weight was thrown on the valve, the body of it broke off and the steam escaped through the full area of the valve seat, severely scalding the engineer. The as-



Section of Safety Valve

sistant engineer immediately started the injector, keeping the water above the danger line, and after the steam had blown off the boat was picked up by another steamer and towed into port.

Examination of the valve showed that the valve seat, which was made of composition and forced into the body of the valve, had a lip around the outer edge which formed a recess or pocket all around the lower part of the chamber in which water collected and laid, the drain hole from the chamber having been drilled some distance above the bottom. This accumulation of water rusted the wall of the chamber away at the points marked *A* in the accompanying sketch until it was as thin as a sheet of writing paper, and the extra strain thrown on it by the weight of the engineer was sufficient to break it off.

This boiler had been tested a short time previous to one and one-half times the working pressure, but investigation showed that the valve had been held down while the pressure was being applied by a clamp or gag that hooked under the chamber below the damaged portion, so that there was no strain at all on this part of the chamber at this time. J. S.

New London, Conn.

Experiments in Coal Consumption

The data given below are the result of a series of experiments which were carried out by the writer in order to determine roughly whether or not a saving could be effected by using only a part of the furnaces in a Scotch boiler instead of all of them. These experiments are not given with any idea that they are scientifically correct, but it is believed that they are sufficiently accurate to prove of interest to the users of Scotch marine boilers.

The conditions under which the tests were made were the ordinary port conditions of a cargo steamer. The coal used in all tests was the same; the maximum and minimum load conditions were the same; the personnel of the fireroom was the same; the weather conditions were ap-

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proximately the same (midwinter in northern waters) throughout the whole series of experiments.

The boiler in use in port was one of the ship's main boilers (no donkey boiler was installed), a large double-ended six-furnace Scotch. Opposite furnaces had a common combustion chamber, that is, the corresponding furnaces in each end of the boiler led into the same combustion chamber. The two connecting furnaces were separated from each other by a high bridge wall.

There was a considerable amount of auxiliary machinery installed on board, so the steam consumption was fairly high at all times. It was the custom to keep fires in all six furnaces of the boiler for port use. This made the work of firing very light, as the fires could be kept banked nearly all the time. The coal consumption under such conditions was about 6.0 to 6.25 tons per day.

It was suggested to the writer that a saving in coal could be made by using only a part of the furnaces in each boiler instead of all of them, as was the custom. In order to determine the merits of this contention, a series of tests under three different conditions was carried out. These conditions were as follows:

(A) Fires were kept burning in the four wing furnaces, that is, in two furnaces in each end of the boiler, the center furnaces remaining dead. The dead furnaces were made as nearly airtight as practicable by plastering up the furnace front with sheets of heavy paper.

(B) Fires were kept burning in three furnaces, that is, in two wing furnaces in one end and in the center furnace in the other end of the boiler. Other furnaces were closed as before.

(C) Fires were kept burning in the two center furnaces, one in each end, with the four remaining furnaces dead. Dead furnaces were sealed as before.

The results of the experiments were:

Under condition "A."—Time during which the test continued was 104 hours. Coal was burned at the rate of 6.25 tons per day. Steam was easily kept up by these four furnaces, with only moderate working of fires. No leaks or other signs of exceptional boiler strains were visible. It should be noted in this case that one combustion chamber was entirely dead and that the other two each had two furnaces discharging into them.

Under condition "B."—Time during which the test was continued was 48 hours. Coal was burned at the rate of 6.96 tons per day. This coal consumption was so much above that of the first test (also of that for all six furnaces) that it was not considered worth while continuing more than 48 hours. In this case each combustion chamber had one dead furnace and one with fires connected to it. Steam was kept up without very much difficulty.

Under condition "C."—Time during which this test continued was 48 hours. Coal was burned at the rate of 6.23 tons per day. Although only two furnaces were in use in this case, the coal consumed was almost equal to that when four were burning. It was necessary to work the furnaces quite often, and considerable difficulty was had in keeping up enough steam for all the auxiliary machinery. On account of this difficulty of meeting any sudden demand for steam the test was discontinued at the end of 48 hours. During this test signs of unusual strains in the boiler appeared. Many small leaks were observed along seams and around rivets in the vicinity of the two wing furnaces at each end. It is believed that these were caused by the unequal expansion and contraction of the boiler, due to the necessity for forcing the fires in the center furnaces while the wing furnaces were cold.

Immediately following these tests the coal used with all six furnaces burning was carefully measured for a period of 10 days. The consumption proved to be 6.1 tons per day.

A summary of the results obtained showed that the coal consumption in tons per day was: with six furnaces burning, 6.1; with four furnaces burning, 6.25; with three furnaces burning, 6.96; with two furnaces burning, 6.23.

It will be observed that the consumption when all furnaces were in use was less than for any other combination. This is believed to be caused by the fact that under these conditions all air getting into the boiler must be heated, whereas under all other conditions there is a passage for air to get to the uptake without being highly heated. Even when the furnace fronts are well covered to prevent the passage of air through dead furnaces leaks still occur.

With two furnaces in use, and with four furnaces in use, results were almost the same, but were slightly higher than when all six were burning.

With three furnaces in use the coal consumption took a large jump upward. This is believed to be due to the fact that each furnace was discharging into a combustion chamber which opened directly into a dead furnace on the opposite side. The combustion chamber was too large for one furnace under the best of conditions, and with the cold air from the opposite furnace getting in it proved to be very inefficient.

As a result of these tests the former custom of using all furnaces in the boiler under steam was continued. As previously stated, these tests were not performed under laboratory conditions, nor were they performed by especially trained men, so their exactness is open to some question. It is believed, however, that they should prove of interest to many engineers, and that they may excite enough curiosity to induce some inquisitive engineer to repeat them under different conditions. If they should do this, their publication is well justified.

W. W. B.

Saved by Uncle Sam's Bounty

The splendid work of United States revenue cutters in assisting distressed merchant vessels has evoked numerous complaints of late from wrecking and towboat companies, who have protested to Uncle Sam that his sturdy white sentinels of the coastwise traffic were taking the very bread from their mouths.

Their objections have fallen on deaf ears at Washington, however. It is pointed out that the assistance of the vigilant cutters is usually rendered at the psychological moment, when to summon the most efficient wrecking outfit, unless it were actually on the scene, would be futile and preposterous. Moreover, there are very few merchant skippers who do not endorse the brave labors of the Revenue Service from the bottom of their hearts.

The grievances of the wrecking concerns, however, are not likely to be lessened by the salving, on October 20, of the *Alice Howard*, one of two ferry steamers owned by the Atlantic Shore Railway and operating between Portsmouth, N. H., and Kittery, Me. The *Howard* ran ashore on a ledge off Clark's Island, Portsmouth Harbor, during a fog. A hole was stove in her, she filled and tilted by the head almost on her beam ends, until her hurricane deck forward was submerged in deep water.

The case obviously was a ligitimate one for a wrecking company. Powerful apparatus was to be had from Boston within a few hours, but the owners of the steamer knew a trick worth two of that. They appealed to Capt. Harry A. Field, U. S. N., Commandant of the Portsmouth Navy Yard. He obligingly furnished them with a big floating derrick, and the sunken *Alice Howard* was raised and beached at Kittery Point for repairs.

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Marine Articles in the Engineering Press

Descriptions of Some Special Types of Ships—Decline of the Sailing Ship—Marine Engine Construction in Germany

The Manufacture of Heavy Chains.—The replacement of chains by steel wire rope for many purposes of lifting and hauling is commented upon, but also that many special cases open up again new fields for chains specially of heavy character. The experiments to produce chains by machinery are not pronounced to be very successful, as the welding particularly requires the utmost scrutiny by personal supervision, while great advantages are secured by machinery for the manipulation of the forging and heating fires and for the cutting and bending of the stock as well as for the testing of the completed chains. A description of the plant, operation and product of the chain forge of the D. E. M. A. G. in Duisburg, with forty-two fires and the necessary machinery for cutting, bending, smoothing and testing, is given. 5 illustrations. 1,250 words.—*Schiffbau,* October 14.

The Application of the Cruiser Stern to Merchant Vessels.—Attention is directed to the influence that a modification of the stern toward the form used in warships might produce in decreased resistance and improved earning capacity. The French magazine, *Le Yacht,* is quoted with a comparison of a ship of ordinary form of stern with a number of designs with cruiser stern and varying fullness, showing a larger useful load per ton of burnt coal for the latter type. Notice is taken also of some model experiments in the tank of the German Government comparing the two forms each at two correspondingly equal displacements at progressive speeds from 15 to 24 knots. The cruiser-stern type showed at a speed of 21 knots a saving of 4.9 percent of power at 15,090 tons displacement and of 6.9 percent at 14,129 tons displacement. 5 tables, 4 diagrams. 850 words.—*Schiffbau,* September 23.

Shallow Draft Steamer for the Yangtse Kiang.—Messrs. Yarrow & Co., Ltd., Scotstoun, recently constructed for the Szechuan Steam Navigation Company, the shallow draft tunnel steamer *Shu-Hun* for their passenger and cargo service between Ichang and Chungking on the Yangtse River. Hitherto it has been necessary for small steamers in this service to be warped up the rapids, but in this new vessel the aim was to provide sufficient power for the vessel to negotiate the rapids under her own steam without the assistance of warps. The vessel was built with a length of 190 feet, a beam of 30 feet and a draft of 5 feet when loaded with 300 tons of cargo. The hull is divided into nineteen compartments by transverse and longitudinal bulkheads and watertight doors are also fitted to the bunker bulkheads. Accommodations for European passengers and the officers are on the boat deck, while the accommodations for the Chinese first class and second class passengers are on the upper deck. On the main deck there is accommodation for 170 Chinese steerage passengers, 15 firemen and three Chinese engineers. The petty officers, deckhands and cooks are berthed in the forecastle. There are five separate holds for cargo with a total capacity of about 16,000 cubic feet. The propelling machinery consists of two sets of triple expansion surface condensing engines, aggregating 2,000 indicated horsepower. Steam is supplied by two Yarrow patent double-ended watertube boilers, operating under forced draft and arranged to burn either coal or coal and oil. The propellers operate in tunnels arranged according to the Yarrow patent system, although in this case the flap is made self-balancing. The forward part of the tunnel forms part of the hull in the usual way, but the after part is hinged at a point about the center of the tunnel and the flap is balanced by means of weights attached to the end of a chain which passes over pulleys, so that the flap automatically regulates itself according to the draft and the pressure of water on the after part of the tunnel. 13 illustrations. 1,600 words.—*Engineering,* November 6.

200-Ton Floating Crane of the Norwegian Navy.—The necessity of lifting appliances is stated to have impressed the Norwegian naval authorities at the time of ordering submarine vessels with the necessity of purchasing the largest floating crane. The design as proposed by and accepted from the Frederikstad mek. Verkstad is said to embody into a harmonious unit hull and cane machinery, securing thereby stability conditions more favorable than required. The stated dimensions of the hull are 110 feet long by 53 feet beam by 14 feet deep, with double bottom and trim tanks of such proportions and capacity to limit the list of the crane to not more than 4½ degrees with 200 tons 8 feet 4 inches forward of the bow. The crane girder is of triangular skeletonized section, moved at its end up or down by a large nut on a single screw spindle 11⅜ inches diameter by 33 feet 4 inches long. The details of the crane machinery for the two loads of 200 tons at 8 feet 4 inches and 25 tons at 62 feet 6 inches distance from the bow are given, with special reference to the provisions for automatic braking by four Weston clutches in connection with spur-gearing. The description of the machinery includes two compound engines and two boilers with the auxiliaries of centrifugal trim pumps, capstans, etc. The tests are stated to have been very satisfactory and in excess of all requirements for speed and capacity. 6 illustrations. 1,600 words.—*Schiffbau,* October 14.

Typical Ships—No. VI—A Steam Trawler.—All trawlers are usually built greatly in excess of Lloyd's requirements so that they will be able to withstand the rough treatment to which they are subjected when returning to port with a catch and crowding in among their competitors at the dock. Under these conditions a vessel of light construction would inevitably meet with serious damage. Seaworthiness is largely attained by having a very great freeboard forward which is a common characteristic of trawlers. The question of speed is not considered of importance and the majority of trawlers are capable of doing only about 10 knots. Although most of the trawlers' hulls conform to a general design, no attempt has been made to standardize their construction. The forecastle is used as the crew's quarters. Aft of this is the fish well, and further aft a bunker which can also be used for fish. In the stern are the machinery and the officers' quarters. The pilot house is usually just forward of the funnel. Although a return tubular boiler and triple expansion engine is always fitted in these boats, no attempt is made to standardize trawler machinery. The vessels described in the article were built by Messrs. Cochrane & Sons, of Selby, who did the hull work, and Messrs. C. D. Holmes & Co., of Hull, who built the engines. The particular vessel described is the *Mena,* built for Roberts & Ruthven, Ltd., of Grimsby. She is 122 feet long, 22 feet 3 inches beam, and 12 feet 4 inches molded depth, arranged for fishing in the North Sea or off Iceland. The

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fish hold is divided up into a number of small divisions, so that different classes of fish can be kept separate. Many of the trawlers have their holds insulated, although no such provisions were made in the *Mena*. The main engine is a three-cylinder triple expansion engine 12½ inches, 22 inches and 35 inches diameter by 24 inches stroke, running at about 110 revolutions per minute, using steam from a single-ended two furnace Scotch boiler, working at 180 pounds pressure. The air, feed and circulating pumps are driven direct off the crossheads. 10 illustrations. 3,000 words.—*Engineering,* October 16.

The Decline of the Sailing Ship.—The returns of Lloyd's Register for the last few years show that there has been a steady decline in the construction and operation of sailing ships, and, if this rate of decrease were to be continued, it is obvious that such ships would soon disappear altogether. Under the conditions affecting the use of sailing ships, however, it is rather improbable to anticipate that the demand for sailing ships will die away entirely for a long time. A fact which makes for the continued existence of the sailing ship is the development of the internal combustion engine used as an auxiliary. Considerable progress has already been made in this line, although the outcome is, of course, simply a problem in economics. In this case, however, the price of oil is a matter of far less moment than in the case of a ship which depends wholly for her propulsion on internal combustion engines. Many voyages of the auxiliary sailing ships are made without using the auxiliary power at all. In the small vessels, however, the tendency is undoubtedly to increase the use of motor boats and to abandon sailing vessels. Although the number of sailing ships is steadily decreasing, it should be noted, however, that the average size of sailing ships has increased in recent years rather than decreased. There are many sailing ships of between 1,600 and 2,000 tons, which are giving admirable service, and they serve as an excellent school for training apprentice seamen for the merchant marine. 900 words.—*The Engineer,* October 23.

The Quadruple-Screw Turbine Express Steamer Imperator.—By comparison with the then largest British ships the author shows the *Imperator* exceeding all previous vessels at the time of entering into service. Details are given of the hull, ballast capacities and structural details. In the description of the machinery plant due attention is paid to the boilers, being of watertube type, forty-six single-ended in four boiler rooms, built for 235 pounds, fitted with Howden draft from 4-foot to 14-foot fans, with 4-foot suctions, and served by the usual reciprocating pump auxiliaries. The turbines, four in number, of mixed type, with 61,000 indicated horsepower ahead and 33,500 indicated horsepower backing, have very efficient handling gear for best economy and show the usual careful details of modern turbines in material, blading, packing, stuffing boxes, foundations, thrustblocks, forced lubrication and lifting arrangements, as well as in condensers, independent auxiliaries, shafting and propellers. Of the hull auxiliaries are described the rudder with gear and engine, windlass, chains and warping gear; further, the ventilators for machinery and quarters; the electric plant, steam heating, refrigerating plant, with pumps and tanks, steam and electric winches, bilge, sanitary and ballast pumps and air compressors. The navigating, safety and fire alarm and extinction apparatus appears to be unusually complete, including also emergency gasoline (petrol), electric light plant, wireless outfit signal apparatus, lifebelts and lifeboats with davits. The last part of the article describes the passenger accommodations, with all recent improvements and necessary adjuncts for service. 13 tables, 52 illustrations, 11,600 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* June 20 and 27.

The Development of German Marine Engine Construction.—This is a review of the development of marine engine building of the last decade, as mainly exemplified by the activity of the shipyard "Weser" in Bremen. It deals with the latest phase of building Scotch boilers over 17 feet diameter and over 21 feet long, at working pressure up to 235 pounds, with hot-forced draft up to 2½-inch water pressure, accompanied by retarders and recently by frequent installations of firetube superheaters. It points out the great advance made by watertube boilers, first for the navy, with closed fire rooms and drafts up to 8 inches of water pressure, and recently for the merchant marine, as exemplified in the *Imperator* installation, with forced draft of Howden type. The promising possibility of oil fuel is mentioned, provided the price of fuel oils remains low. It is stated that the reciprocating engine is still leading on freight steamers, with refinements in the direction of full balance, independent auxiliaries and condensers, gradual introduction of superheated steam and oil separators and possibly wider installation of poppet valve engines. For large powers the turbine is considered a necessity, an intermediate stage being the combination of high-pressure reciprocating engines with exhaust turbines. The mixed turbine systems are considered the type of the future for large powers, as accentuated by the German navy in standard single-shaft units. Gear and transformer transmissions of high-speed turbines to low-speed large propellers are pronounced a success and very promising commercially for freight steamers. Oil engines are stated to be only temporarily under a cloud of disfavor, as the difficulties so far experienced can readily be overcome by better material and workmanship and by more familiarity of the engineers. 39 illustrations. 11,000 words.—*Zeitschrift des Vereines Deutscher Ingenieure,* July 4 and 11.

GROWING BAY STATE PORTS.—While the oft-repeated slogan "Sail from Boston" has boosted Hub commerce into the front rank in the last few years, the business of other Bay State ports has been taking rapid strides as well. A demonstration attended the arrival at Beverly recently of the steam collier *Malden* of the New England Coal & Coke Company, the largest vessel ever entering that port. She brought 7,280 tons from Newport News, inaugurated a regular service between the two places and wrested honors from the new oil tanker *Gulfstream,* which had held the distinction of being the largest ship Beverly had known. Beverly was already a distributing station for the Gulf Refining Company, and had a considerable traffic in that commodity. The deepening of the ship channel of the historic port of Plymouth has lately permitted the entry of ocean-going steamers with cargoes of hemp from Progreso, Mexico, for the Plymouth Cordage Company, which until now has received its consignments via Boston. Little towns on Barnstable and Buzzard's bays expect to receive a decided stimulus through the opening of the Cape Cod canal, while Rockport, the home of famous Cape Ann granite, pins its hopes on the completion of the colossal Sandy Bay breakwater, which has been under way for 25 years.

MARINE ENGINEERS' CONVENTION.—The National Marine Engineers' Beneficial Association will hold its fortieth annual convention at Washington, D. C., January 18 to 23, 1915, with headquarters at the Raleigh Hotel.

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New Books for the Marine Engineer's Library

Useful Books for Applicants for a Marine Engineer's License —Some Important Subjects Treated in an Elementary Manner

INDICATOR DIAGRAMS FOR MARINE ENGINEERS. Third edition. By W. C. McGibbon, M. I. E. S. Size, 7½ by 9½ inches. Pages, 178. Figures, 197. Glasgow: James Munro & Company, Ltd. New York: D. Van Nostrand Company. Price, $3.00.

While most marine engineers are familiar in a general way with a steam engine indicator and its use in the determination of the power of an engine, it is not always easy for the engineer to analyze an indicator card and pick out the faults in the engine shown by the card. This, however, is one of the most important functions of the indicator, and especially when the engineer can find the necessary remedy to apply to an engine to overcome the defects shown by the cards. The book under review contains a great many examples of defective diagrams with a most instructive analysis of the cards showing the cause of defects and how they may be remedied. This book is highly recommended for its practical suggestions, and a copy should be in the library of every first class marine engineer.

MARINE ENGINEERS' DRAWING BOOK. By W. C. McGibbon, M. I. E. S. Size, 12 by 9½ inches. Pages, 124. Plates, 51. Glasgow, 1913: James Munro & Company, Ltd. New York, 1913: D. Van Nostrand Company. Price, $2.00.

On account of a great change which has recently come over the requirements of the Board of Trade in drawing examinations, the author of this book, who is principal of the Glasgow School of Marine Engineering, has found it necessary to get out a new edition of the book in order to meet more fully the needs of applicants for a marine engineer's license. In the Board of Trade examinations at present the candidate is expected to design and give a full dimension drawing of engine parts. Instructions for such work are given in this book in the form of large, fully dimensioned drawings arranged in the form of plates, while on the page opposite each plate is given the statement of the problem in the form it would be given to the candidate in his examination, and below this instructions showing the formulas and calculations necessary for determining the dimensions of the various parts which are to be reproduced in the drawing. This book will be found of immense value to candidates for a Board of Trade examination, and is well worth a careful study even by men who are not confronted with the necessity of passing an examination and yet find it necessary to make detailed sketches of marine machinery.

POWER AND POWER TRANSMISSION. Third edition. By E. W. Kerr, M. E. Size, 5¾ by 9 inches. Pages, 373. Illustrations, 325. New York, 1914: John Wiley & Sons, Inc. London, 1914: Chapman & Hall, Ltd. Price, $2.00 net.

Although the first edition of this work was published in 1901, it has been found necessary in the third edition to revise and rewrite a large part of the work, and make considerable additions. The book is arranged in three parts, dealing respectively with mechanics, steam power and other power machinery. The first part contains chapters on shafting, bearings, friction and lubrication, friction wheels, pulleys, belt gearing, toothed wheels, the screw, cams, the lever, link work and pipe fittings. Part II contains chapters on the simple steam engine, high speed engines, indicators, compound engines, condensers, valves and valve gearing, rotary engines and steam turbines. Part III contains chapters on pumping machinery, internal combustion engines, water power and compressed air. For a book of this size to cover so many subjects, it is not to be expected that each subject has been treated exhaustively, the greater part of the work is descriptive, although the general principles of the operation of the various types of machinery described are explained with the aid of line drawings and diagrams. As a brief treatment of the subjects discussed, the book will be found useful.

MATHEMATICS FOR THE PRACTICAL ENGINEER. By Charles H. Bromley and Henry R. Cobleigh. Size, 5½ by 8¼ inches. Pages, 220. Illustrations, 70. New York, 1914: McGraw-Hill Book Company, Inc. Price, $2.00 net.

FUEL ECONOMY AND CO_2 RECORDERS. By A. R. Maujer and Charles H. Bromley. Size, 5½ by 8¼ inches. Pages, 189. Illustrations, 28. New York and London, 1914: McGraw-Hill Book Company, Inc. Price, $1.50 net.

These two books are made up of material previously published in the Engineers' Study Course in *Power*.

The first book, which treats the subject of mathematics in an elementary manner, aims to bridge the gap between practical operating experience and the technical knowledge needed in modern practice by giving engineers the necessary mathematical foundation. Any man who has found his lack of education in mathematics a barrier towards advancement in the engine room will find this book most helpful. It begins with a chapter on vulgar or common fractions, then takes up denominate numbers, percentage, ratio and proportion, square and cube root, formulas, logarithms, mensuration and finally ends with a brief chapter on plain trigonometry. The information is given in plain every-day language which can be readily understood.

The second book deals principally with combustion. The authors point out that the cost of fuel in most plants is between 60 and 70 percent of the total cost of power. Too many people fail to realize the possibilities of waste in the boiler room and the causes of waste which might easily be eliminated. If combustion means to the fireman only the maintaining of a fire hot enough to keep the steam gage indicating the correct pressure, his advancement to the position of an engineer will be slow and laborious. He will find that there is much to be learned about the principles of combustion, the analysis of fuel and flue gases and the losses of heat in the flue gases. This book gives a clear insight into such matters and also takes up the subjects of evaporation, boiler efficiency, heat balance, feed water treatment and CO_2 recorders. While the book is prepared especially for stationary engineers, it will be found equally useful for marine engineers.

THE NAVAL POCKET-BOOK, founded by Sir W. Laird Clowes and edited by R. C. Anderson, has just been published by W. Thacker & Co., London, E. C., with corrections to April 8, 1914. This is the nineteenth year of publication of this volume and it is arranged in the same manner as the previous editions, with tabulated data of the navies of the world, tables of naval guns, a list of dry docks throughout the world and plans of armored ships. The only changes are the natural extensions and corrections of the data to cover the progress of the past year. The book is 3½ by 5 inches in size and contains over 700 pages. The price is 7s. 6d. net.

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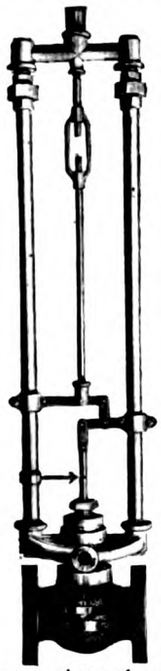
ENGINEERING SPECIALTIES

McDonough Feed Water Regulator

The McDonough Automatic Regulator Company, of Detroit, Mich., has placed on the market an automatic feed water regulator of the thermostatically controlled type. The main purpose of its design is to secure not only a continuous feed, but positive automatic control of a continuous feed to vary with the boiler load and maintain a water level within limits best suited for constant maximum boiler capacity, efficiency and uniformity of operating conditions. It is claimed that the regulator in actual operation maintains a continuous feed proportional to the evaporation and for light loads and uniformly varying loads a constant water level. On the other hand, for sudden increase in load and resulting rapid drop in water level, the regulator valve does not open suddenly to admit



a large quantity of water into the boiler, but there is a time element in the expansion of the tubes operating the valve which uniformly increases the feed, permitting the immediate furnace heat to be used for evaporating water and not heating cold feed. In this manner of feeding it is claimed that the maximum capacity of the boiler, with greater uniformity of furnace conditions, is maintained and boiler strains are avoided.

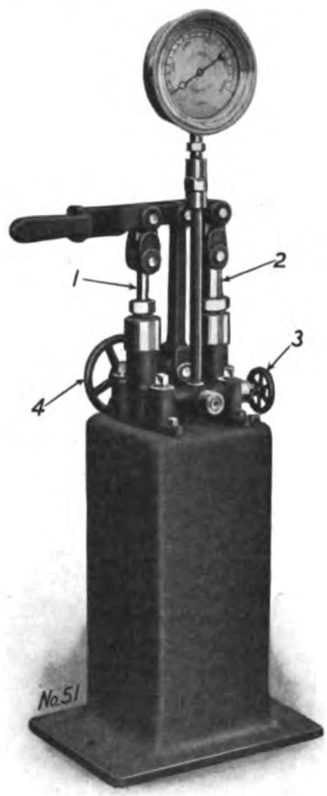
The regulator is complete in itself, consisting of a special feed valve, two headers and two expansion tubes connected in parallel through a rigid linkage to the feed valve stem. The use of two expansion tubes doubles the power of expansion and contraction and the levers transmit the motion to the feed valve in a ratio of 5 to 1. The turnbuckle and pointed indicator, it is claimed, permit the very accurate adjustment of the valve, and further, the pointer indicator shows at each instant the position of the valve while the regulator is in operation.

The regulator is installed in an inclined position, wholly supported by the feed piping with the connections made to the water column as shown. In operation the lower end of the tubes are filled with water and the upper with steam. As the water falls or rises in the boiler, it correspondingly falls or rises in the regulator tubes, presenting a greater or less area of the tube surface to the hot steam, causing them to expand and contract accordingly. The inclined position of the regulator gives the greatest variation in exposed tube surface for a given variation in water level, and the greatest sensitiveness to variations in load.

Double Piston, High-Pressure Hydraulic Pump

A. L. Henderer's Sons, Wilmington, Del., have placed on the market a combined quick-acting and high-pressure hydraulic pump for general purposes. While continuous pumping may be had while the two pistons are in action, the principal feature of the combination is the variation of pressure.

This pump can be applied to various usages, one of which is in conjunction with a ram for use as a hydraulic jack. The time required pumping the ram to the load with a maximum pressure single piston pump is readily realized, while in this combination of ¾-inch and 1½-inch



pistons the time reduction is three quarters. With the combination of ¾-inch and 1½-inch pistons 6,000 pounds per square inch can be had from the former and 1,000 pounds from the latter, and it is to be noted that the low-pressure piston is on the upward stroke of the lever and the high-pressure on the downward stroke.

In the illustration the No. 1 piston is the high-pressure. The No. 2 piston is the low-pressure, and when its capacity is to be exceeded it is disengaged by means of the release wheel No. 3, leaving the piston No. 1 free for higher duty, and which latter is in operation under all working conditions. Complete release of all load pressure is by means of the release wheel No. 4, which governs the return of the liquid to the pump's reservoir.

The pump as illustrated has a stroke of 3 inches, total height of 34½ inches and weight of 190 pounds, with reservoir base of 1,200 cubic inches, but the capacity of base can be changed to suit immediate needs, as can the diameters of the piston for working pressures.

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Personal

E. V. Jones has been appointed chief engineer of the Louisiana Railroad & Navigation Company's steamer *Lewis.*

E. C. Cornelius has been appointer assistant engineer on the Atlas Cement Company's steamer *Josh Cook* at New Orleans, La.

Harry J. Thompson has succeeded A. J. McMillan as chief engineer of the Associated Bar Pilot's tug *Jenny Wilson,* at Port Eads, La.

Floyd F. Woods has been appointed sales manager of the Epping-Carpenter Pump Company, Pittsburg, Pa., succeeding Mr. R. Bowen, resigned.

John F. Ward, formerly chief engineer of the steamer *Old Colony,* has accepted a position as engineer with the Illuminating Company at New Haven, Conn.

Sid. P. Terry, chief engineer of the Ohio River Steamboat *Johns Summers,* was off duty recently for several days on account of sickness. During his absence Samuel Shoemaker acted as chief engineer of the vessel.

Charles Delecroix has been appointed chief engineer of the Monongahela & Consolidated Coal Company's towboat *Finlay.* This boat recently left New Orleans, La., for Pittsburg, Pa., with a full tow of empty coal barges.

William Simonds, formerly chief engineer of the Louisiana Railroad & Navigation Company's transfer steamer *Lewis,* has been appointed chief engineer of the United States Navigation steamer *Ram,* at New Orleans, La.

A. S. Halligan has succeeded A. J. Taylor as chief engineer of the steamer *New Camilia.* The *New Camilia* has resumed her old trade on Lake Pontchartrain, replacing the new steamer *Hanover,* which will engage in the excursion business in the harbor of New Orleans until next spring.

William P. Lindley, chief engineer of the steamship *Lewis Luckenbach,* of the Luckenbach Steamship Company, has resigned his position with the company, the vacancy being filled by William G. Perow, formerly first assistant engineer of the steamship *Newport,* of the Pacific Mail Steamship Company.

Charles Johnson has resigned as chief engineer of the British steamer *Greenbrier.* This vessel has just been purchased by the United Fruit Company and is being fitted out to carry a full load of cotton from New Orleans to Bremen, Germany, at the rate of $17.50 (3/12/11) per bale. It is estimated that, if she arrives safely at Bremen, she will have paid for herself in this single voyage.

Captain E. A. Burnside, manager of transportation of the Campbell's Creek Coal Company, Point Pleasant, W. Va., had charge of the company's towboat *Eugene Dana Smith* on her first trip to Cincinnati, Ohio, after the low water which has prevailed through the season. In the keen competition with other boats taking advantage of this first rise of water, Captain Burnside brought his tow into Cincinnati ahead of any other vessel, an achievement that is readily appreciated by the Western river pilots, who are familiar with the hazards attending such a task.

George H. Highbee, vice-president and general manager of the Pacific Coast Steamship Company, has submitted his resignation, to take effect on January 1, on account of ill-health. Mr. Highbee was formerly associated with the firm of Peter Wright & Company, agents for the American and Red Star lines on the Atlantic coast. In 1898 he went to the Pacific coast as general manager of the Empire Line, but returned to New York to become identified with the International Mercantile Marine. In 1906 he again returned to the Pacific coast to take up the duties of president of the Moran Shipbuilding Company, Seattle, Wash., a position which he held until 1908, when he became associated with the Pacific Coast Steamship Company.

Naval Constructor David W. Taylor, U. S. N., received his appointment as chief constructor of the navy on December 14, and with it the rank of rear admiral. Rear Admiral Taylor is the senior naval constructor in the navy and formerly held the rank of captain. He was born in Philadelphia on March 4, 1864, and graduated from the naval academy in 1885 at the head of a class which was noted for the number of brainy men that composed it. He received a higher rating at the academy than has ever been given before or since that time. After a few months at sea following his graduation from the academy, he was ordered to England to take up the study of naval construction at the Royal Naval College, Greenwich. His standing at that institution paralleled his record at the United States Naval Academy. His work as a naval constructor for the twenty-eight years since his appointment has been conspicuous. In recent years he has been in charge of the work at the experimental model basin at the Washington Navy Yard, where his researches in hull design have been of inestimable value to the world. His published works, both in the form of papers read before the leading institutions of naval architects in the world and in books which have become classical, stand foremost in the literature on naval architecture. His position as the senior naval constructor, his official record, and his service and international reputation, all make him the natural selection as chief of the bureau of construction of the Navy Department.

Obituary

Colonel Edward Daniel Meier, president and chief engineer of the Heine Safety Boiler Company, and former president of the American Society of Mechanical Engineers, died in New York on December 15 at the age of seventy-four.

Charles A. Moore, president of Manning, Maxwell & Moore, Inc., New York, who sailed from New York on December 1, on the Holland-America steamship *Rotterdam,* for Naples, Italy, died from heart disease at sea. Early in 1862 Mr. Moore enlisted in the navy and served as a member of the crew of the *San Jacinto.* Soon after the war Mr. Moore entered the industrial field, and achieved a far-reaching success in the organization and direction of industrial companies. He was a man of wide interests, including both industrial, political and social. He was a director in many of the largest corporations in the country, and a valued member of many organizations and clubs. His age was sixty-eight years.

Rear Admiral Alfred Thayer Mahan (retired), noted as naval expert and writer, died in Washington, D. C., December 1, at the age of seventy-four. Mr. Mahan was graduated from the Naval Academy at Anapolis and promoted through the various grades until as a captain in 1896 he retired at his own request. During the Civil War he served on the ship *Congress* and on the south Atlantic blockading squadrons. Rear Admiral Mahan has served at various American naval stations throughout the world. He has been president of the Navy War College at Newport, and, during the Spanish War, was a highly valued member of the Naval Board of Strategy. In 1899 he was a delegate to the Hague Peace Conference. He is widely known throughout the world as the author of many authoritative works on naval history and sea power.

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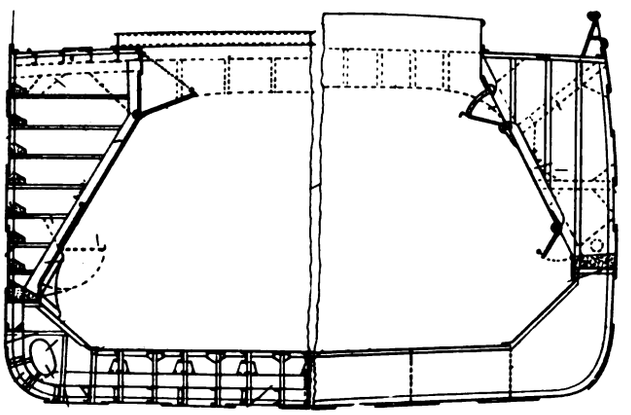
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,110,077. CONSTRUCTION OF SHIPS AND OTHER VESSELS. JOSEPH R. OLDHAM, OF CLEVELAND, OHIO.

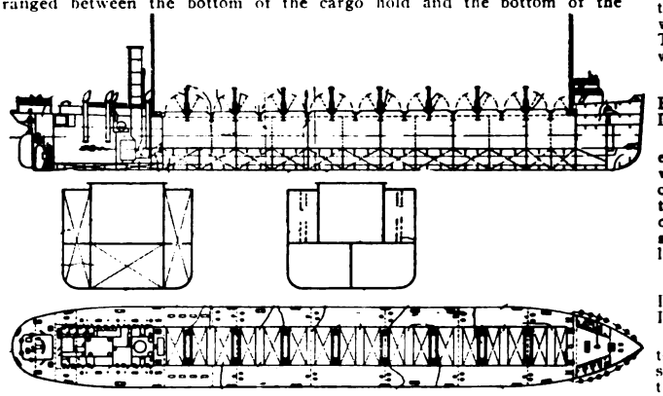
Claim 1.—In a steel bulk-cargo vessel having a water bottom with lower side tanks, longitudinal bulkheads extending diagonally inward from the top of the water ballast tanks at sides to the deck at the sides



of the hatchways, throughout the cargo holds, the upper part of said bulkheads being perforated to form chutes to admit bulk cargo into the side holds, with apertures at the lower part of said bulkheads to emit the cargo into the main holds, substantially as and for the purpose specified. Eleven claims.

1,111,740. ORE, BULK OR DENSE CARGO CARRIER. HUGO P. FREAR, OF SAN FRANCISCO, CAL., ASSIGNOR TO BETHLEHEM STEEL CORPORATION, OF SOUTH BETHLEHEM, PA., A CORPORATION OF NEW JERSEY.

Claim 1.—A vessel comprising an outer main shell, a longitudinally extending cargo hold arranged centrally within the main outer shell with its bottom wall elevated a substantial distance from the bottom wall of the main shell, closed side tanks arranged between the cargo hold and the side walls of the main shells and adapted for the reception of a liquid ballast or liquid cargo, and closed lower tanks arranged between the bottom of the cargo hold and the bottom of the



main outer shell and extending completely across the bottom of the cargo hold, said lower tanks being divided by a central closed bulkhead and having open communication to said side shells, and the combined capacity of said side tanks and lower tanks being greater than the capacity of said cargo hold, and means for introducing and withdrawing liquid ballast into each of the lower closed tanks. Seven claims.

1,112,138. SIGNAL-BUOY. HORACE H. HILL, OF SOMERVILLE, AND ROLLIN ABELL, OF BOSTON, MASS., ASSIGNORS TO SUBMARINE SIGNAL COMPANY OF BOSTON, MASS., A CORPORATION OF MAINE.

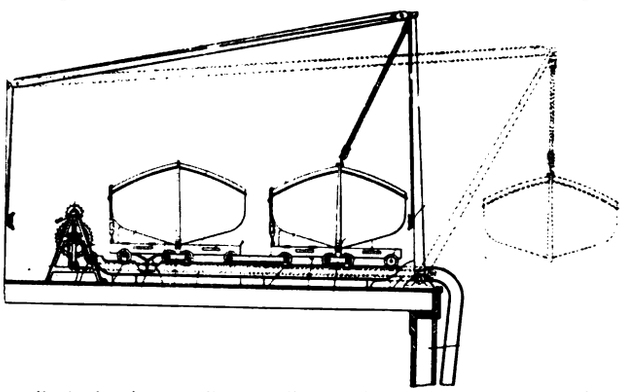
Claim 1.—In a signal-buoy, in combination, a signaling means, a pair of power-storing devices, means operable by wave motion, means for operatively connecting one of said power-storing devices to said wave operated means to cause power to be stored and for simultaneously causing the disconnection of the other of said devices from said wave operated means, and means for operatively connecting each of said devices with said signaling means when disconnected from said wave operated means. Eight claims.

1,118,499. APPARATUS FOR LAUNCHING LIFE-BOATS FROM DECKS OF SHIPS. SIMON LAKE, OF MILFORD, CONN.

Claim 8.—The combination with a ship, of a series of frames journaled on the side thereof in step-like order and extending from the boat-deck of the ship to the waterline, a horizontal boat-supporting member carried by each frame and having rollers mounted thereon, a transversely arranged track mounted on said boat-deck, forming extensions secured to the ends of the rails of said track and adapted to be extended transversely of the ship, a boat-carriage operable on said track, and a life-boat adapted to be rendered air and watertight carried by said carriage, said boat having longitudinal parallel skegs adapted to engage the rollers of said horizontal members of the frames when passing over said members. Fourteen claims.

1,111,836. LAUNCHING DEVICE. JOHN ALBERT JOHNSON AND JOSEPH W. LUDLAM, OF OAKLAND, CAL.

Claim 1.—A boat handling mechanism comprising in combination, a track mounted on the deck of a ship and extending from a point inboard to the edge of said deck and then down the side of the vessel for a substantial distance, said track being extended outward from the edge of the vessel at the level of the track and then bending in-



wardly in its downwardly extending portion, and a train mounted on said track, said train comprising a plurality of trucks pivotally linked together, and means for retaining said trucks on said tracks when they are lowered over the side of the vessel. Two claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

21,844/1913. IMPROVEMENTS IN ICE-BREAKING STEAMSHIPS. SIR W. G. ARMSTRONG, WHITWORTH & CO., LTD., AND E. L. ORDE, THE WALKER SHIPYARD, NEWCASTLE-ON-TYNE.

Where ice-breaking steamers are working in certain parts of the world, they sometimes meet a serious obstacle in the shape of spongy ice, known by the name of "frazil" or "lolly" ice, which is often found extending some 20 to 30 feet below the sheet of solid surface ice. A slight increase in temperature of the surrounding water is found sufficient to dissolve this "frazil" ice. According to the invention, the temperature of the surrounding water is raised by injecting steam or heated water into it by means of a special arrangement of steam heaters fitted in convenient parts of the bottom or sides of the ship. The heaters are similar to ordinary steam ejectors, and are provided with an inlet for the cold water from outside, an outlet for the heated water and a steam nozzle. These nozzles are supplied by steam pipes. The heaters are arranged in watertight compartments.

25,414/1913. IMPROVEMENTS IN ARRANGEMENTS FOR IMPELLING WATER THROUGH SHIPS' CONDENSERS. H. OECHSLIN, FLITWICK ROAD, AMPTHILL, BEDFORDSHIRE.

The object of the invention is to provide a substitute for the hitherto employed types of pumps within one of the pipe lines of the condenser, with a consequent saving of space and increase of efficiency of the circulation. Sea water is conducted by a pipe from an intake in the side of the ship to the condenser and discharged through a similar outlet; two or more axial-flow turbine pumps may be fitted to impel the water in series, either secured on the same or different shafts in the same pipe line, or in separate pipe lines.

26,229/1913. IMPROVEMENTS IN SLIDING WINDOWS AND DOORS FOR SHIPS. G. PATE CARRON CO., CARRON, STIRLINGSHIRE AND R. B. KINNIBURGH.

Claim.—The glass holder or sliding sash is provided with rack and teeth. Gearing with these racks are spur pinions centered loosely on studs secured in the frame of the window near the lower extremity of the sash. When it is in its highest or closed position, these pinions also gear with teeth formed on balance weights, which weights travel parallel to the sash but in the opposite direction thereto, so that as the sash is opened or lowered, the weights rise and *vice versa*. Both the sash and weights are provided with guide grooves or projections which engage corresponding groves on the fixed frame and curve flats.

21,007/1913. HEATING AND COOLING AND VENTILATION APPARATUS FOR THE USE IN SHIPS. W. N. HADEN AND OTHERS. (TRADING AS G. N. HADEN AND SONS), ST. GEORGE'S WORKS, TROWBRIDGE, WILTSHIRE.

Claim.—Consists of apparatus for heating or cooling and ventilating compartments on ships wherein the air for each compartment passes through a series of tubes in some of which the air is heated and is then cooled, means being provided for causing the air to pass through the heaters or cooling tubes, as desired. The air may be heated by means of hot gases or water, and the air may be cooled by a cooling medium from a refrigerator.

1,320/1914. IMPROVEMENTS IN THE METHODS OF CEILING ORDINARY FLOORS IN SHIPS. J. MACGREGOR, 56 BEDE BURN ROAD, JARROW-ON-TYNE.

Claim.—This invention relates to improvements in the methods of ceiling ordinary floors in ships, having for its principal objects such alterations as will dispense with wood ceiling on ordinary floors. In addition, this invention obviates the necessity of lifting the wood ceiling when liquid cargo is to be carried. Portable strakes of iron plating are fitted onto reverse bars, on the top of ordinary open floors, between fixed rider plates, which form the top members of the center and side keelsons, the rider plates being fitted flush with the top of the ordinary floors. The portable strakes are butted where double reverse bars are fitted and refastened to reverse bars by tap screws or other suitable means.

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